

VETERINARY OBSTETRICS

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VETERINARY OBSTETRICS

INCLUDING CERTAIN ASPECTS OF THE PHYSIOLOGY AND
PATHOLOGY OF REPRODUCTION IN DOMESTIC ANIMALS

By

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PREFACE

WHEN Professor Franz Benesch's book "Geburtshilfe bei Rind und Pferd" was first published in English in 1938 under the writer's editorship with the title "Veterinary Obstetrics," several useful criticisms were made by those reviewing it. It was suggested that the inclusion of an account of the normal process of parturition in animals would have been a valuable preliminary to the description of the methods of combating dystocia in them. It was thought by some that British veterinarians would welcome in a book such as this the inclusion of a consideration of obstetrical problems in other species in addition to the bovine and equine.

It was with these points in mind that the writer embarked on the preparation of the present volume. On collecting his thoughts he came to the conclusion that it would be an advantage considerably to increase its scope and include not only the subjects previously mentioned but others also. Among them was a consideration of some aspects of the physiology of reproduction, a knowledge of which is essential to an understanding of reproductive errors; the œstrous cycle; the changes which occur in the various parts of the female genital tract during the heat cycle, pregnancy and the puerperium. The detection of pregnancy forms such an important preliminary to investigations into reproductive disorders that it was clear a consideration of it must be included also. The operation of cæsarian section has now attained an established position in bovine obstetrical practice as well as in that of the smaller animals, and thus it also should have a place. The control of infertility in animals now forms an important part of the veterinary surgeon's work and, as it is a subject closely allied to obstetrics, chapters relating to it should be introduced.

Thus the present book evolved.

The material in it has been divided into three parts. The second of these is the original text of Professor Benesch on the treatment of dystocia in the cow and mare by manipulation *per vaginam*. This needs no introduction, for it has attained high, international repute. The first and third parts have been prepared by the writer and for them he is solely responsible. No attempt has been made to cover the

entire field of reproductive physiology and pathology in the female, but rather those parts of these sciences have been selected of which the writer has had personal experience and an understanding of which he has found essential to his clinical work. He is convinced that there is a great need for such a book and trusts that what has been included will be found helpful both to practitioners and students in their work.

Grateful acknowledgement is made to Dr. D. E. Bartlett of the Zoological Division of the Bureau of Animal Industry, U.S.A., for permission to reproduce his illustrations and charts in relation to *Trichomonas fetus* infection in cattle, and to Professor E. C. Amoroso of the Royal Veterinary College, London, for allowing the inclusion of his observations on the œstrous cycle in the cat. To the Editor of the *Veterinary Record* acknowledgement is made for the permission to reproduce illustrations which have accompanied the writer's articles in that journal. Finally, special thanks are due to Mr. A. C. Shuttleworth, Senior Lecturer in Veterinary Surgery, University of Liverpool, who has prepared the half-tone illustrations which appear in Parts 1 and 3 of the book from sketches made by him of post-mortem material and during the course of operations, and also to the publishers of the book, Messrs. Baillière, Tindall and Cox, for the great care and trouble they have taken in its preparation.

JOHN G. WRIGHT

LIVERPOOL,
October, 1950

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PART I (J. G. WRIGHT)

CHAPTER 1

THE ŒSTROUS CYCLE

THE onset of puberty in the female is characterized by the commencement of recurring periods of sexual desire. While it is generally regarded as an indication that an animal has attained adult life, sexual maturity precedes full physical development and under conditions of domestication its onset often occurs while females are still very young and quite immature physically. This is most noticeable in the bovine, in which species the mating of calves during their first year of life is a common source of difficult birth.

In nature it is the general rule that animals breed once annually and parturition occurs in the spring, the time most favourable to the young in that they grow up during the period of increasing light and warmth and also at the time when food for the mother is most abundant, and adequate lactation is ensured. Under the conditions of feeding and housing provided by domestication, breeding periods tend to be lengthened and some of our species, particularly the bovine, may breed at any time during the year.

None of the domestic species undergoes a physiological change comparable with the menopause of woman, and provided animals are healthy and well cared for they continue to have sexual cycles throughout their lives.

The recurring sexual periods or œstrous cycles are associated with the ripening in the ovaries of one or more graafian follicles and in the majority of mammals culminate in the shedding of one or more ova. If fertile mating has occurred, pregnancy ensues, and in its absence the cycle recurs. While this generalization holds good for most of the domestic species, it will be noted later that in the bitch the heat period is not recurrent but bi-annual and in the absence of pregnancy is succeeded by pseudo-pregnancy. Moreover, ovulation is not a constant feature of heat. In some species, and notably, from the veterinarian's viewpoint, the cat and the rabbit, the shedding of ova

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PART I
(J. G. WRIGHT)

CHAPTER 1

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is dependent on the physical act of coitus and without it the mature follicles regress.

The stimulus which initiates ovarian activity is hormonal in nature and is elaborated in the anterior lobe of the pituitary gland. It is termed gonadotrophic hormone. The activity of the anterior pituitary gland would appear to be influenced by various factors, of which adequate nutrition is one of the most important. Light is another. The action of light differs, it would seem, according to the length of gestation in the particular species. In the mare, for instance, with her gestational period of eleven months, the onset of sexual cycles occurs with the increasing daylight of February and March; whereas in the ewe, with her gestation time of five months, the commencement of heat cycles coincides with the shortening daylight in September and October. In the southern hemisphere, where the seasons are approximately the opposite to those in England, these animals show heat during the months equivalent to them. Even in the bovine species, in which recurrent heat cycles recur throughout the year, there is a constant tendency for animals to calve during the spring and early summer, and the practice of withholding service until after Christmas, so that they shall calve in the winter and thus ensure an adequate winter milk supply for mankind, is often associated with delay in conception.

Gonadotrophic hormone is responsible for follicle maturation, ovulation and the formation of lutein tissue in the follicle from which the ovum has been expelled. Two fractions have been isolated; the first, which is essentially responsible for the growth of the follicular system in the ovary, is termed *follicle-stimulating hormone*, and the second, which is chiefly concerned with luteinization, *luteinizing hormone*. The distinction between the two fractions, however, is by no means absolute and their action is essentially a synergistic one (Robson, 1940). The luteinizing factor, for example, has no effect on an ovary which has not previously been under the influence of the follicle-stimulating fraction. Moreover, while both fractions are capable of provoking ovulation, optimal conditions are dependent on the two being present in definite concentrations.

Ovaries which have been activated by gonadotrophic hormone themselves elaborate an *oestrogenic* or heat-provoking hormone termed *astrin*, which is produced both by the follicles and the stroma cells. This hormone is responsible for the increase in secretions of the uterus, cervix and vagina, the changes in the form of the epithelial cells of the vagina and all the external signs and changes which accompany heat.

The *corpus luteum*, which develops after ovulation, produces during its period of activity a hormone, *progesterone*, the chief functions of which are associated with pregnancy, but which in the absence of pregnancy inhibit the actions of gonadotrophic hormone during the period between recurrent heats.

The œstrous cycle is divided into the following phases:

1. **Proœstrus**—the phase immediately preceding œstrus. This is characterized by a marked increase in the activity of the reproductive organs. The follicle (or follicles) which is to rupture at the subsequent œstrus, undergoes rapid enlargement. The uterus enlarges; its mucosa becomes congested and œdematous, and its glands active. The vaginal mucosa becomes hyperæmic; its epithelial cells undergo changes which in the majority of species comprise cornification, and its secretion is increased. In the bitch the vulval discharge is blood-tinged during this phase.

2. **œstrus**—the period of acceptance of the male. The uterine cervical and vaginal glands secrete much mucus of fluid consistency. The vagina and vulva become enlarged and tumefied. The animal seeks the male and "stands" for him to mate her. The cervix is relaxed.

3. **Metœstrus**—the phase succeeding œstrus. The epithelial cells lining the ruptured follicle undergo rapid hypertrophy and become luteinized, forming the corpus luteum. The blood vessels and glands of the uterine mucosa become very active. Mucous secretion from the vagina is decreased; it contains normal epithelial cells and leucocytes.

4. **Diœstrus**—the rest period between successive cycles. Graafian follicles are developing slowly. The uterus and vagina are anæmic and their glands inactive. The cervix is constricted and vaginal secretion is scanty and sticky.

5. **Anœstrus**—The prolonged period of sexual rest during which ovarian function is largely in abeyance. Follicle development is absent or slight only. The uterus is small and anæmic; vaginal mucus is scanty and tenacious.

THE MARE

In the mare the sexual period is seasonal. In the British Isles heat commences in February or March and recurs at intervals until September or October, after which the majority of mares become anœstrus until the following year, although some, particularly if they are housed and well fed, may continue to have heat cycles during the winter.

Küpfér (1928) in South Africa noticed that the œstrous periods were relatively frequent, but that there was no regularity in the duration of

heat signs, and that the intervals between successive periods varied also. Heat signs may be seen for a day and then disappear; they may persist for several days. In a third form, a relatively long period may be preceded by a short period of one or two days. In regard to the relationship between œstrus and ovulation, Küpfer's conclusion was that ovulation did not occur during every heat period; it was generally present during the periods of longer duration and absent from the short periods which preceded the longer ones.

Day (1939) as the outcome of his studies of mares in England puts the average duration of œstrus at 6 days, but with variations from 3 to 65 days. He points out that in mares which have been anœstrous during the winter there is a tendency for the early heat periods in the following spring to be of long duration, generally 10–15 days, although they may even be much longer. The diœstrous phases following such heats also tend to be long, 18–30 days. As the season advances, however, both œstrus and diœstrus shorten, until by May most mares are having a normal cycle of 6 days' œstrus and 15 days' diœstrus.

Hancock (1948) observing mares from May onwards, found the average duration of œstrus to be 5.1 days and of diœstrus 16 days, with a mean interovulatory period of 21 days. Van Rensburg (1949) in South Africa found that mares which continued to show irregular heat during the winter months failed to conceive to repeated service.

Hammond (1938) observed that ovulation in the mare occurred about 24 hours before the end of œstrus, irrespective of its duration, and that the highest percentage of conceptions resulted from matings taking place from 2 to 4 days before the end of heat. Hancock (1948) also found that the majority of ovulations occurred within the 48 hours preceding the termination of œstrus; in the majority on the 4th or 5th days after the onset of heat. He also noted that conception occurs when mating takes place within 48 hours of ovulation.

The onset of heat after foaling generally occurs on the 8th to 10th day, and it is the time-honoured practice amongst breeders to introduce the mare to the stallion at that time. The "foaling heat" is often a short one, of 2–4 days' duration, and it is the practice to serve the mare as soon as heat is displayed and again introduce her to the horse 48 hours later. A high percentage of conceptions occurs from such matings. If this heat is lost there is a risk that subsequent ones may be so slight as to pass unnoticed. Tutt (1944) observed 43 thoroughbred mares and noted that in 39 of them the onset of heat occurred in from 8 to 13 days after foaling. 69 per cent. conceived to services during this heat.

Signs of Heat

The mare becomes restless and irritable; she frequently adopts the attitude of urination and voids small quantities of urine, with repeated exposure of the clitoris. She may remain in this attitude for several minutes at a time. The tail is raised and often held to one side. The vulval labiæ are puffy and there is a mucous discharge. In breeding studs a "teaser" is often employed to detect in-heat mares. The stallion is introduced to the mare with a gate or a stable door between them. If she turns her hind parts towards him, stands quietly and raises her tail to one side, it may be taken that she is in heat. A mare which is not in season generally squeals and kicks at such treatment.

Changes in the Ovaries and Vagina

In their quiescent state during winter anæstrus, the ovaries of the mare are small and bean-shaped. There is no significant difference in size between those of the light and heavy breeds. Their dimensions are approximately 6 cm. from pole to pole, 4 cm. from the hilus to the free border, and 3 cm. from side to side. During their active state they are generally larger, variations being dependent on the number and size of the follicles they contain.

Küpfer (1928) questions the belief that there is a predestined ovulation groove or fossa in the ovary of the mare and donkey. In his view the ovulation groove is purely a morphological conception and that the emission of the follicular contents from the surface of the ovary is physiologically the same in the horse as in other mammals. He states that secondary growth processes in the ovary of the horse result in the formation of a groove-like depression in old animals. In support of his contention it must be acknowledged that recent corpora lutea are generally found on the convex border or at the poles.

Day (1938) has given a clear picture of the changes which occur in the ovary during the heat cycle. Just before the onset of the first spring heat a number of follicles enlarge to a size of 1–3 cm. By the first day of œstrus one follicle is generally considerably larger than the remainder, having a diameter of 2.5–3.5 cm. During œstrus this follicle matures, and ruptures when it has attained a size of 3–7 cm. With ovulation the other follicles commence to regress, until during the first 4–9 days of diœstrus, no follicles larger than 1 cm. are likely to be present. On ovulation the enlarged follicle collapses, forming a recognizable indentation on the surface of the ovary. There is generally some hæmorrhage

into the follicle. Hardening occurs during the next 24 hours and by 72 hours after ovulation the corpus luteum cannot be detected. This body attains its maximum size in 4-5 days. It does not protrude from the surface of the ovary, as it does in the cow, and on palpation is indistinguishable from the remainder of the ovary. Its appearance on section is similar to that of the corpus luteum of the cow, although its colour is rather a paler yellow and its shape more conical. Its centre is generally occupied by a variable amount of blood-clot. From the 9th day onwards the events previously described recur.

Amoroso and Rowlands (1948) have noted that ovulation during the oestrous cycle occurs more frequently in the left than the right ovary. In a series of 24 mares whose ovaries were palpated per rectum during 45 cycles, 36 single and 9 twin ovulations occurred. Of the single ovulations, 22 were from the left and 14 from the right ovaries, while of the

OVARIES OF THE MARE, FIGS. 1-5
(Half natural size)

5-year-old Farm Mare

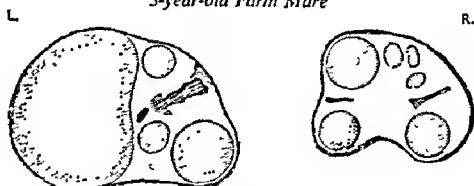


FIG. 1.—IN HEAT.

Specimens obtained in May. Regressing C.L. in left ovary, bright yellow-ochre in colour.

9-year-old Farm Mare

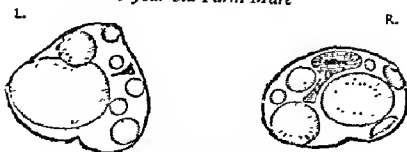


FIG. 2.—DIESTRUS.

Specimens obtained in March. C.L. in right ovary, orange in colour; pleats loose.

4-year-old Shire Mare

FIG. 3.—DIESTRUS.

Specimens obtained in May. C.L. in left ovary, brownish-red in colour; pleats distinct; central cavity containing blood clot. Right ovary contains a follicle filled by blood clot.

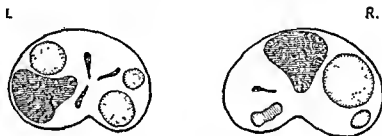
6-year-old Farm Mare

FIG. 4.—DIESTRUS.

Specimens obtained in June. A C.L. in each ovary; pleats distinct; colour orange-yellow.

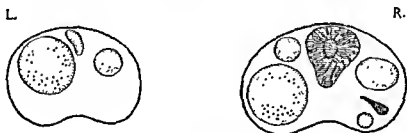
6-year-old Hunter Mare

FIG. 5.—DIESTRUS.

Specimens obtained in October. C.L. in right ovary; pleats distinct; colour pale yellow. Central cavity.

twin ovulations, 4 occurred in the left and the remaining 5 involved both ovaries.

Hancock (1948) records similar findings: of 35 single ovulations, 22 occurred in the left ovary. Of 10 twin ovulations 4 occurred in the left, the remainder being divided between the ovaries.

By visual examination of the vagina and the vaginal protrusion of the uterine cervix using an illuminated speculum, it is possible to detect the preovulation period. In diestrus the cervix is tightly constricted and

its protrusion erect; the vagina and cervix are pale pink in colour, while mucin is scanty and rather tenacious. During œstrus there is a gradual increase in the vascularity of these structures and relaxation of the external os occurs. As œstrus advances and ovulation time approaches, the cervix becomes very relaxed and its protrusion can be seen lying on the vaginal floor with its folds œdematous. After ovulation there is a gradual reversion to the diœstrus appearance. During anœstrus, as in pregnancy, the vagina and cervix have a blanched appearance; the cervix is constricted and generally turned away from the midline and the external os is occupied by sticky mucin.

THE COW

From the onset of puberty, under conditions of domestication and provided the animal is normal and well cared for, œstrous cycles recur at regular intervals throughout the year, until pregnancy ensues. The duration of the heat period is relatively short, averaging 15 hours and ovulation occurs some 14 hours or so after the period of acceptance has ended. Exceptionally, ovulation may be delayed for longer periods. The period between heat phases is fairly regular, varying within normal limits of 18–23 days. Proœstrus is short and represents the 24–36 hours which precede heat, while metœstrus comprises the 4–5 days following heat.

Hammond (1927) states that ovulation occurs 24–48 hours after the beginning of heat, probably at about 48 hours.

Brewster and Cole (1941) found the average duration of heat in dairy breeds to be 15 hours and in beef breeds 13·7 hours. Working with a mixed herd of 53 individuals, these workers found the average time of ovulation to be 13·57 hours after cessation of heat, with a range of from 2 hours before to 26 hours after cessation.

Nalbandov and Casida (1942), observing 68 periods in dairy cows, found that ovulation occurred within 22 hours of the end of heat, the mean being 14·16 hours. In two cases ovulation was delayed 47 and 104 hours, and in two others the follicles regressed without ovulation occurring. One animal on two occasions ovulated before the end of heat. The average time at which dairy cows went out of heat was 8·52 p.m. on the same day it was observed, and in beef cattle the average time of ending was 10·32 p.m. on the same day.

Quinlan, Roux and van Aswegen (1939), in 383 observations in 28 Sussex × Africander heifers, found the average period between two heat phases to be 20·3 days. 91·12 per cent. fell in a range of 18–23 days. Among the abnormal periods were short cycles of 14–17 days—3·39 per cent.; long cycles of 24–27 days—2·35 per cent.; and half cycles of 8–10 days—1·04 per cent.

Cattle, particularly heifers maintained at a low nutritional level, may pass into a state of anœstrus. This is especially liable to occur in the autumn and winter. Moreover, animals which are housed, especially

those giving high yields, may develop silent heat (subœstrus)—a condition in which there are no visible heat signs although the ovaries are undergoing their normal cyclical changes.

The onset of the first heat after parturition varies. It often occurs in from 2 to 3 weeks; it may be delayed for 2–3 months. It is thought to occur earlier when the animal is being milked than when suckled. In this connection, however, the development of silent heat causes confusion.

Signs of Heat

The detection of heat is one of the most important duties of the herdsman when, as is the custom in dairy herds, the male is segregated, and considerable skill in the recognition of its signs is necessary if loss of breeding time is to be avoided. There are marked variations in the intensity of heat signs in individuals. In heifers they are generally, but by no means invariably, well marked. In many cattle, especially those which are housed, they may be so slight as to pass the notice of even the most careful observer. Many herdsmen acquire great skill in the detection of the very slight changes in the behaviour of their charges which indicate heat. Thus the veterinarian if he is to avoid erroneous conclusions when investigating infertility, must consider with great care the value of the heat records presented to him.

The animal in heat is generally restless; she tends to remain standing rather than assume recumbency, and appetite, rumination and milk yield may be reduced. The tail is often raised. At grass the affected animal tends to separate herself from the remainder of the herd. She frequently arches her back and stretches herself. Often she bellows. She may follow and mount other cows and “stands” for other cows to mount her. There is a flow of colourless, transparent mucus from the vulva. Often it is found adherent to the tail or flanks. The vulva tends to become swollen and congested, although this is not a marked feature. The vulval discharge often culminates, especially in heifers, in a flow of blood. This is an indication that heat has passed. When introduced to the bull the in-œstrous female may “play” with him; she licks him and allows him to lick her. She stands still and allows him to mount her.

Changes in the Vagina

The changes in the vagina of the cow during the œstrous cycle have been studied, amongst others, by Hammond (1927), Cole (1930), Dougherty (1941) and Brown (1944). The chief changes occur during the heat period itself and the two or three days succeeding it. During

œstrus the epithelium becomes greatly thickened, this change being most marked in the area adjacent to the cervix. Instead of undergoing cornification, as occurs in most species, the superficial epithelium takes the form of tall, columnar, mucus-secreting cells. During diœstrus the cells of the superficial layer vary from flat to low columnar. There is little or no leucocytic invasion during heat; it attains its maximum 2-5 days after œstrus has passed off. Mucin is secreted in large quantities by the cells of the anterior vagina and cervix. It commences in proœstrus and attains a maximum during heat, when it is copious, transparent and colourless and flows readily.

Scott Blair *et al.* (1941) have introduced a simple instrument, the œstroscope, designed to measure the flow elasticity of the cervical mucus, a property which has a regular variation throughout the sexual cycle and attains a sharp maximum about the time of heat.

As heat passes off there may be a discharge of blood from the uterus. (The author has observed on the post-mortem examination of specimens of heifers, that associated with a corpus luteum of about 24 hours' duration, the endometrium of the cotyledonary areas shows congestion and petechiation.) The amount of mucin becomes reduced and is less fluid and contains floccules. During diœstrus, the cervical and anterior vaginal mucus is scanty, sticky and pale yellow to brown in colour. Hyperæmia of the mucosæ of the vagina and cervix commences during proœstrus and attains a maximum at œstrus. At this period the cervical prominence becomes tumefied and relaxed and several fingers can be inserted into the external os. During metœstrus there is a rapid reduction in vascularity, and in from 3 to 5 days after the cessation of heat the mucosa has resumed its quiescent, relatively anæmic state. During diœstrus the cervix is pale, the external os is firmly constricted and mucus scanty.

It has long been thought that the reaction of the normal bovine vagina is alkaline, in fact acidity has been regarded as a cause of infertility. The work of Dougherty (1941) and later that of Brown (1944) throw doubt on this belief. The latter worker, making *in vivo* determinations, found the pH to be relatively constant, 86 per cent. of a total of 807 readings being between 6.5 and 7.5, the range being 6.2 and 8.3 and the average approximately 7.0.

Changes in the Ovaries

The size and contour of the ovaries will depend on the phase in the cycle in which they are examined. It is best to commence a study of the subject by a consideration of the organs of a mature but unbred heifer.

If such ovaries are examined post mortem, section will reveal the most significant structures in them to be graafian follicles and corpora lutea.

Graafian Follicles. At any time during diœstrus there will be found several comparatively large follicles, of diameter varying from 0·7 to 1·0 cm. One will probably be a little larger than the others. Had the ovary been palpated in the fingers before cutting it, it would have been possible to detect relatively soft areas on its surface with a fluid wave beneath, but the general oval contour of the ovary would not be appreciably altered by the presence of these follicles, nor would it have been possible to make more than a rough estimation of their size. Exceptionally, a follicle makes a discrete bulge from the surface, while on other occasions one of the larger follicles is so compressed by the other ovarian structures that it becomes flattened in outline and appears to have a diameter of 1·5 cm. or more. These latter instances are due to a lack of space within the ovary due to the close proximity of an active corpus luteum or of other follicles. During proœstrus and œstrus the follicle which is soon to rupture undergoes enlargement, and ovulation generally occurs when it has attained a size of 1·5 cm. (Hammond, 1927). (The limits of size within physiological normality which a follicle may attain before rupture are not known, but it is probable that exceptionally one attains a greater size than that quoted.) On rectal examination of the ovaries of an animal which is in heat, it is generally possible to detect a slightly bulging, soft area on the surface of one of them which represents the follicle undergoing pre-ovulation enlargement.

Joss (1916) concluded after a study of the blood supply to the cow's ovary that ovulation occurred at a certain area of the wall of the follicle free from blood vessels, similar to the stigma or cleavage lines which occur in the ripe follicles of fowls. The author has noted that in the majority of corpora lutea examined by him there is no blood-clot present. In a minority, however, there is blood-staining of the luteal cells, particularly at the protrusion, and also there is sometimes blood-clot in the centre of the corpus luteum. He has noted also in cows killed towards the end of the heat period a small pin-head papilla raised from the surface of the follicle, similar to that described in the ewe by Grant (1934). Ovulation may occur from any aspect of the surface of the ovary, and the shape of that organ subsequently when the corpus luteum is fully developed will be chiefly influenced by this site.

The Corpus Luteum of Œstrus. On rupture the ovum is expelled through a small breach in the surface of the follicle and, consequent on the escape of the greater part of its fluid, the latter collapses. If the

opportunity had arisen for repeatedly carrying out rectal examinations during heat and for the 24 hours succeeding it, this collapse of the follicle would have been detected. If such an ovary is examined post mortem, it will be seen that the surface from which ovulation has occurred is wrinkled and possibly blood-stained. The corpus luteum develops by hypertrophy and luteinization of the granulosa cells lining the follicle. Enlargement is rapid. By the 48th hour after ovulation it has attained a diameter of about 1.4 cm. Its colour is dull cream and the luteinized cells can be seen in the form of loose pleats. The corpus luteum attains its maximum size by the 7th to 8th day of diœstrus. The luteinized pleats are now relatively compact and the body comprises a more or less homogeneous mass, yellow to orange-yellow in colour. Its shape varies; the majority are oval, but some are irregularly square or rectangular. The greatest dimension of the fully developed structure varies from 2.0 to 2.5 cm. Its weight also varies. In the author's series, fully developed corpora lutea have varied from 4.1 to 7.4 g. (Similar variations also occur in the weights of the corpora lutea of pregnancy—3.9 to 7.5 g.) Sometimes the centre of the yellow body is occupied by a cavity. This has been seen in 25 per cent. of those collected by the author. The size of the cavity varies; in the majority it is small, averaging 0.4 cm. in diameter, but occasionally it is large, up to 1.0 cm. or more. It is occupied by yellow fluid. In the cases just described there is evidence of ovulation by the presence of a pin-head depression in the centre of the projection of the body from the surface of the ovary, and this serves to differentiate them from the common abnormality of the cow's ovary—luteinization of the walls of the follicle without ovulation. Nevertheless, it is probable that this is the condition which has been described in the past as cystic corpus luteum and regarded as pathological. The author believes the presence of a cavity to be normal. (It might well be asked, Is there ever a central cavity in the corpus luteum verum? The author has never seen a corpus luteum of pregnancy with a cavity, but he has encountered many in which the centre is occupied by white connective tissue, and he concludes that these originally contained cavities.)

The Projection of the Corpus Luteum from the Surface of the Ovary. As the corpus luteum enlarges it tends to push itself out of the ovary, stretching the surface of the latter, until by the time it attains maximum development it forms a distinct projection. The degree and type of this projection vary. In the majority it is a distinct bulge about 1.0 cm. in diameter with a clear-cut constriction where it joins the general contour of the ovary. In other cases it is nipple-like. In a third type the projection

is indistinct but diffuse and occupying the greater part of the pole of the ovary. It would seem that the type of protrusion which develops depends on the extent of the surface of the ovary occupied by the follicle just before ovulation (see Figures).

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The Ovaries of the Multiparous Cow. The ovaries of the normal multiparous cow do not differ greatly from those of the heifer or first calver. They tend, however, in many cases to be larger. This increase in size is due in part to the progressive deposition of scar tissue resulting from prolonged function and in some cases also to the presence of large numbers of small but visible follicles. Not infrequently the ovary which does not contain a corpus luteum measures 4.0 by 3.0 by 2.0 cm. Nevertheless, it is generally possible in mid-œstrus to detect the corpus luteum, for, quite apart from its protrusion, the ovary containing it is plum-like, whereas the other is distinctly flattened from side to side. On section of such ovaries, the corpora lutea, active and regressing, and the follicles approaching maturity are identical with those described for the heifer. There is, however, an additional structure to be recognized—old scarred corpora lutea of previous pregnancies. They generally show a white, pin-head-sized projection on the surface of the ovary and on section are found to comprise mainly scar tissue. They are irregular in outline, with a maximum dimension of about 0.5 cm. Their colour is white (corpus albicans) or brownish-white. The corpus luteum of pregnancy does not atrophy after parturition as quickly as does that of œstrus after it has ceased to function. It is an appreciable structure for several weeks after parturition, brown in colour and about 1.0 cm. in diameter. It becomes progressively invaded by scar tissue.

BOVINE OVARIES DURING THE ŒSTROUS CYCLE, FIGS. 6-15
(Natural size)

(Section made from the free to the attached border through the poles)

First-calf Heifers

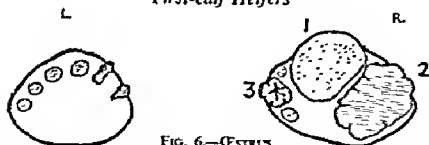


FIG. 6.—ŒSTRUS.

1. Ripe follicle. 2. Regressing C.L., bright yellow. 3. Corpus albicans.



FIG. 7.—ŒSTRUS.

1. Ripe follicle. 2. Regressing C.L., brick-brown.

Unbred Heifer

FIG. 8.—JUST AFTER OVULATION.

1. Collapsed follicle. Surface wrinkled and blood-stained. Petechiæ in wall.
2. Regressing C.L., bright yellow.

Young Cow

FIG. 9.—ONE DAY AFTER OVULATION.

1. Developing C.L. Pleats loose; colour pale cream; central cavity.
2. Regressing C.L., bright orange-yellow; centre filled by connective tissue.
3. Corpus albicans.

Young Cow

FIG. 10.—TWO DAYS AFTER OVULATION.

1. Twin C.L., some hæmorrhage.
2. Regressing C.L., bright yellow.

4-year-old Ayrshire—Two Calves

FIG. 11.—THREE DAYS' METOESTRUS.

1. Active C.L. Pleats loose; colour orange-yellow; central cavity.
2. Regressing C.L., dense and brown.
3. Corpus albicans.

6-year-old Shorthorn—Three Calves

FIG. 12.—FOUR DAYS' METOESTRUS.

1. Active C.L. (orange-yellow). Atypical protrusion.

2. Regressing C.L., small, shrunken, scarlet.

3. Corpus albicans.

4. Follicle.

The fully developed corpus luteum is present by the 7th day and persists unchanged until the onset of oestrus at the 19th or 20th day.

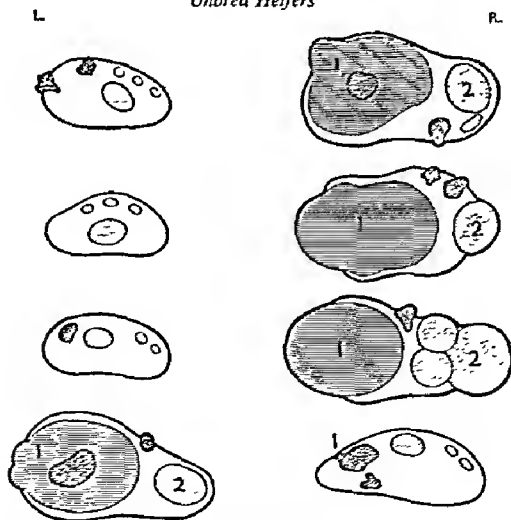
Unbred Heifers

FIG. 13.—OESTRUS.

1. Corpus luteum.

2. Largest follicle.

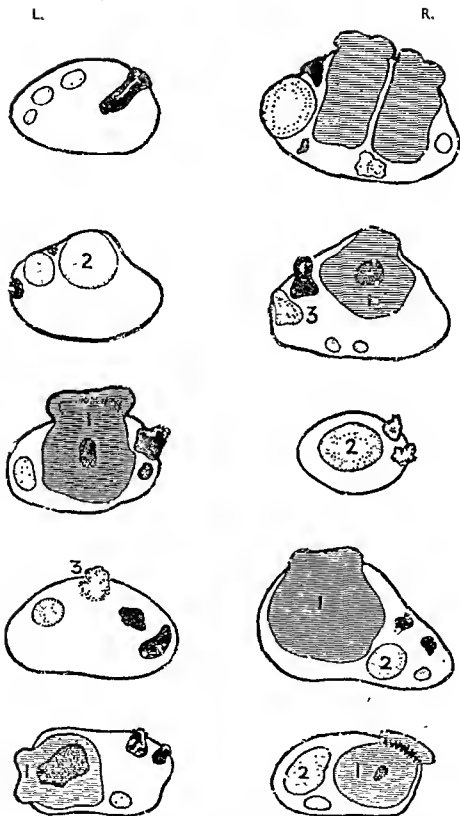
Bred Cows

FIG. 14.—DIASTRUS.

1. C.L. diæstrus.

2. Largest follicle.

3. Corpus albicans.

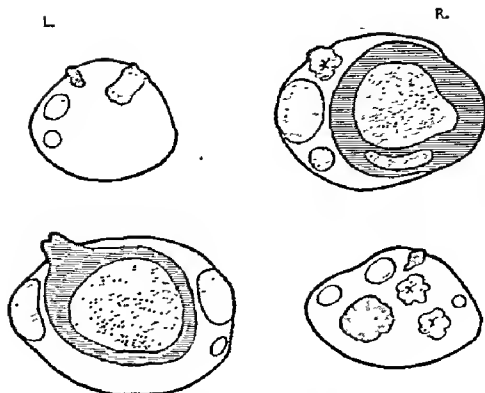


FIG. 15.—EXCEPTIONAL CORPORA LUTEA.

Large and multiple cavities.

THE EWE

The sexual season of most British breeds of sheep, maintained under the climatic conditions of the British Isles, is from October to February, during which time they have eight to ten recurrent cycles. This is followed by a period of anæstrus until the following autumn. According to Marshall (1904) Scottish Black Face ewes in the Highlands have two cycles only. The Limestone sheep of Westmorland and Derby and the Dorset Horn breed have two annual sexual seasons, the first during May and June and the second from September to December. In the southern hemisphere, Australia and South Africa, the breeding season occurs from March to October. In parts of Central Europe the local breeds have no annual anæstrus, and it is reported in Australia and South Africa that the Merino breed may continue to have cycles throughout the year. As has previously been stated, declining light appears to act as a stimulus to the anterior pituitary gland in sheep. The average duration of heat in the British breeds is 24 hours, ovulation occurring towards the end of the period. In Cheviots heat may persist for as long as 35 hours and in Merinos for 48 hours. The diœstrous period varies from 15 to 19 days.

· Signs of Heat

The behaviour of the ewe towards the ram is a reliable indication. A non-receptive ewe trots away when approached by the ram, whereas the receptive one goes to meet him. Attention causes her to waggle her tail and she stands for him to mount. There may be noticeable congestion and swelling of the vulval labiæ during heat, but in this connection there are marked breed variations.

Changes in the Ovaries

The ovaries of the ewe are smaller than those of the cow and their shape is nearer the spherical. During anæstrus their size is approximately 1.3 by 1.1 by 0.8 cm., and the largest follicles present vary from 0.2 to 0.6 cm. At the onset of heat one or more follicles have attained a size of 1.0 cm. Their walls are thin and transparent and the liquor folliculi appears purple in colour. Grant (1934) has observed that rupture of the follicle is preceded by the elevation of a small papilla above the general surface, and ovulation occurs through rupture of this papilla about 24 hours after the onset of heat. The development of the corpus luteum is similar to the cow; by the 5th day of diæstrus it is 0.6 cm. in diameter and it attains its maximum size, 0.9 cm., by the middle of the diæstrous phase, when it has a central cavity. (Roux, 1936.) As the diæstrous period advances its colour changes from blood-red to pale pink. Its size remains constant until the onset of the next heat, when atrophy is rapid and the colour changes, first to yellow and later to brownish yellow. In twin ovulations the corpora lutea may occupy the same or opposite ovaries. During pregnancy the corpus luteum persists from 0.7 to 0.9 cm. in diameter. Its colour is pale pink, but the central cavity has disappeared, having become filled by white tissue.

Ovulation with corpus luteum formation, but without signs of heat, may occur during the so-called anæstrous period—spurious ovulation (Grant, 1934). As to the number of ova shed at a heat period, genetic and nutritional factors play a part. Hill sheep in this country generally have one lamb, but if they are transferred to lowland pastures where herbage is rich (before the onset of the breeding season) twins become the rule. With lowland breeds the general expectancy is an average of 1.5 lambs per ewe. Roux (1936) in South Africa has noted that age is also a factor in the incidence of twinning. It attains its maximum when ewes are 5–6 years old, after which it remains constant.

THE SOW

The mature sow has recurrent heat cycles throughout the year until she becomes pregnant. The duration of œstrus is 2 days and that of diœstrus 19 days. Ovulation may occur on either day of heat. In pig-breeding establishments it is customary for sows to be either pregnant or suckling young continuously. During the suckling period heat is in abeyance. When the young are weaned 8 weeks after farrowing, heat occurs 4 days later. If, however, weaning is delayed beyond the 8th week, the onset of heat varies up to 14 days, after which regular cycles occur until she is again pregnant.

Signs of Heat

King (1947) describes the signs of heat as follows. During proœstrus the sow becomes restless and her appetite reduced. Swelling and tumefaction of the labiæ are marked. There is frequent grunting and she endeavours to escape from confinement. With the onset of œstrus, frequent grunting continues, but the most noticeable feature is that the sow frequently stands motionless in the position for service. This standing can readily be provoked by rubbing the sides of the body with the hand. On introduction to the boar, after a little sniffing around, she stands quite still, grunting continuously. She generally remains quite still during the period of coitus, a matter of 10–15 minutes, but gilts when mating with heavy boars may become fidgety during the later stages due to the great weight of the male.

The Ovaries

The ovaries of the mature sow are relatively large and mulberry-like in appearance. This lobulation of the surface is due to its being almost entirely occupied by large follicles or corpora lutea. The follicles attain a diameter of 0·8–1·0 cm. before ovulation and the fully developed corpora lutea are from 1·0 to 1·3 cm. At first they are blood-red in colour, but later become pale buff.

THE BITCH

The sexual behaviour of the bitch differs markedly from that of the species already reviewed. Heat occurs twice yearly, with an interval of about 6 months. In the majority, the first annual period occurs between January and March and the second during August and September.

This seasonal incidence is not absolute under conditions of domestication, and an occasional in-season bitch may be met at any time of the year.

The Œstrous cycle of the bitch has been extensively studied by Evans and Cole (1931) in America, and the author has drawn freely from their excellent monograph, particularly in regard to the changes which occur in the genital organs, in the preparation of this chapter.

The cycle is divided up as follows:

(a) **Proœstrus.** Is characterized by a flow of blood from the vulva and the progressive enlargement of the labiæ. Its duration is generally 9-10 days, with variations ranging from 4 to 14 days.

(b) **Œstrus.** The blood discharge is reduced or has ceased and there is marked enlargement and tumefaction of the vulva. Its duration also averages 9 days, with a range of from 5 to 12 days. Sexual desire is at its greatest intensity during the first 2 days. It is noticed that when proœstrus is long œstrus tends to be short, and the converse, but the total duration of these two periods generally occupies 18-21 days.

(c) **Metœstrus.** Is characterized by pseudo-pregnancy changes in the endometrium. This period lasts for 8 weeks and often terminates in a phantom parturition with lactation.

(d) **Anœstrus.** Extends from the end of the pseudo-pregnancy phase until the onset of the next proœstrus. Its duration is about 3 months.

Signs of Œstrus

The first indication that heat is approaching is the onset of slight swelling of the vulval lips. This indication generally precedes the commencement of bleeding by several days. Labial swelling is progressive during the proœstrus period. Bleeding attains its maximum early in proœstrus and continues at this level into the early part of the true heat phase. During the greater part of proœstrus the bitch, although attractive to the dog, takes no interest in his attentions. She will not stand for him and generally attacks him if he attempts to mount her. A day or so before the end of proœstrus her attitude changes. She shows signs of courtship towards the male. These comprise sudden darting movements which end in a crouching attitude with her limbs tense and her face alert. She barks invitingly, but as the dog approaches she moves suddenly again. She will not yet allow him to mount. With the onset of œstrus the invitation to coitus is obvious. She stands in the mating position with her tail slightly raised or held to one side. She

remains still while the male mounts and copulates. In the later stages of the copulatory tie, which occupies from 15 to 25 minutes, she becomes restless and irritable and her attempts to free herself may cause the male considerable physical embarrassment. After the first 2 days of heat sexual desire gradually recedes, but with the continued persuasion of the male she will accept coitus until the end of the period. Bleeding, although reduced in amount, generally continues well into the heat period and may persist until the end. More often, however, the discharge becomes yellow in colour as heat proceeds. Vulval swelling and tumefaction are greatest at the onset of the stage of acceptance. During the course of œstrus the enlarged labiæ become softer in consistency. Some labial swelling continues into the first part of the met-œstrous phase.

Changes in the Vagina and Uterus

During anœstrus vaginal smears contain leucocytes and epithelial cells. The former, however, are relatively scanty. With the onset of proœstrus there is a sudden appearance of cornified epithelial cells with an equally abrupt disappearance of leucocytes. The end of œstrus is heralded by the reappearance of leucocytes and small epithelial cells. During the first few days of metœstrus the great number of leucocytes present gives the smear a pus-like appearance.

The vaginal epithelium during the period of sexual rest is of the low columnar, cuboidal types and comprises two or three layers only. During proœstrus the epithelial cells change to the high, squamous, stratified type and persist in this form until the later stages of œstrus. The stratum corneum and the layers immediately beneath it are lost by desquamation during the proœstrous and œstrous periods leaving a low, squamous structure which becomes converted to columnar epithelium in from 1 to 3 weeks after the end of heat. During pseudo-pregnancy (and pregnancy) the epithelium is of a higher columnar type than during anœstrus.

The endometrium of the bitch is of special interest because of the bleeding which occurs during proœstrus and also of the pseudo-pregnancy changes which, in the absence of pregnancy, follow heat. Evans and Cole have noted the simple structure of the uterine glands, the œdematous condition of the connective tissue and the hyperæmia of the capillaries immediately beneath the epithelium, with extravasation into the connective tissue, during proœstrus and œstrus. These workers were unable to find any break in the epithelium and concluded that if

bleeding from open blood-vessels is the correct explanation, they must be few in number and of minute size. The alternative explanation for the presence of erythrocytes in the uterine lumen is that of diapedesis through the intact epithelium.

During proœstrus and œstrus the cornua become enlarged, turgid and circular on cross-section. This contrasts strongly with their relaxed state and flattened appearance during sexual quiescence.



FIG. 16.—THE UTERUS AND OVARIES OF THE IN-ŒSTROUS BITCH JUST BEFORE OVULATION. The right ovary has been sectioned to show the hypertrophy of the follicle wall.

The Ovaries

During the anœstrus the ovaries are oval and slightly flattened in shape. In a bitch of medium size they measure approximately 1.4 cm. from pole to pole and 0.8 cm. from the attached to the free border. No appreciable follicles can be seen, although on section the minute remnants of the corpora lutea of the previous cycle may be seen as yellow or brown spots. In the young bitch the surface of the ovaries is smooth and regular, but in the aged animal it is irregular and scarred. At the commencement of proœstrus developing follicles have already

VETERINARY OBSTETRICS

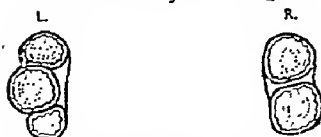
THE OVARIES OF THE BITCH, FIGS. 17-21
(Natural size)*8-month animal of 15-lb. weight*

FIG. 17.—PROESTRUS 2-3 DAYS.
Marked hypertrophy of granulosa cells lining follicles.



FIG. 18.—JUST AFTER OVULATION.
Follicles (right ovary) collapsed. Left ovary shows remnants of corpora lutea of previous heat.



FIG. 19.—LATE IN HEAT
Corpora lutea forming. Pleats loose and flesh-coloured. Central cavities.

25-lb. Cur Bitch

FIG. 20.—PREGNANCY 7½ WEEKS.
Three fetuses in each cornu. Corpora lutea flesh-coloured. Old remnants still visible.



FIG. 21.—FOUR WEEKS AFTER PARTURITION (FIVE FETUSES).
Corpora lutea shrunk and cream in colour.

attained a diameter of 0.5 cm. They progressively enlarge until at the time of ovulation their size varies from 0.6 to 1.0 cm. By this time the ovary is considerably enlarged, its size depending on the number of ripe follicles present, and its shape is irregular due to the projection of the follicles from its surface. Owing to the thickness of the follicle wall it may be difficult to distinguish between follicles and corpora lutea. Prior to ovulation the surface of the follicle shows a slightly raised papule, pin-head in size, and the epithelium covering it is brown in colour, which contrasts with the flesh colour of the remainder of the follicle. A remarkable feature of the ripening follicle of the dog is the thickness of its wall, due to hypertrophy and folding of the granulosa cells. This can be seen on section with the naked eye. Ovulation is spontaneous and occurs about 24 hours after the onset of the period of acceptance. Rupture of all the follicles occurs within a relatively short period. The longevity of the ova in this species is phenomenal. It is probably as great as 4 days. The corpus luteum at first contains a central cavity, but becomes filled by compact luteinized cells by the 10th day after ovulation, by which time the body has attained its full size (0.6–1.0 cm.). Corpora lutea now comprise by far the greater mass of the ovary. As a rule an approximately equal number of corpora lutea are found in each ovary, although occasionally there are wide differences. (In this connection it is interesting to note that the numbers of *fœtus*es in the respective cornua in pregnancy frequently differ from those of the corpora lutea in the ovaries on the respective sides. Embryonic migration into the cornua on the opposite side would appear to be common.) On section the corpus luteum is yellowish-pink in colour; it remains unchanged in the non-pregnant bitch until about the 30th day after ovulation, after which it slowly atrophies. Visible vestiges may be present throughout *anœstrus*. During pregnancy the corpora lutea persist at their maximum size throughout, but regress fairly rapidly after parturition.

THE CAT

Œstrous cycles are seasonal in the cat. They commence in January and attain a peak during March and April. From this point intensity falls and then rises again to reach a second peak period in June, after which it again falls. Sometimes a third phase occurs in September. There are generally two or three cycles in each phase in the absence of pregnancy. During October, November and December this species is *anœstrous*.

The onset of heat is sudden, its duration is 2 to 4 days and it ends abruptly. The average period of dioestrus is 4 weeks. During lactation heat is inhibited, and it recurs 3-4 weeks after weaning. If the kittens are taken away at birth, the cat comes into heat in 3-4 weeks.

Ovulation is dependent on coitus (or some comparable stimulus), and occurs about 26 hours later. The corpora lutea attain their maximum size by the 17th day, when their diameter is 0.3 cm. In the absence of pregnancy following mating, there is a pseudo-pregnancy phase with maximum glandular activity of the uterus at the 20th day. There is quiescence again by the 30th day.

In pregnancy the corpora lutea maintain their maximum size until the 30th day, and from this point slowly regress, although at parturition they are still visible. A striking feature of the cat's ovary is that in an animal from which kittens are removed at birth and which conceives again 3 weeks later, two sets of active corpora lutea will be found in the ovaries, the new and the old. It would seem that the latter under the influence of the former regain functional vigour.

Signs of Heat

The animal seeks the male and utters a characteristic low vocal call. Postural invitation to coitus is evidenced by lowering of the fore part of the body and raising the hind, with a characteristic "pedalling" movement of the hind legs. During coitus the male grasps her firmly at the back of the neck with his teeth. Introduction of the penis is accompanied by a short, sharp cry from the female. Ejaculation is immediate. After disconnecting, the male takes up a position a short distance away and watches her. Her behaviour is characteristic; she rolls vigorously, with her fore and hind limbs fully extended and with a peculiar pronation of the fore limbs—digits splayed and claws exposed. During heat copulation may occur many times.

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CHAPTER 2

PREGNANCY AND ITS DETECTION

THE veterinarian is frequently asked to give an opinion as to whether or not an animal is pregnant. Early knowledge of the fact is often of considerable economic value, while in investigations into infertility, particularly in herds of cattle, it is essential that animals in the early stages of pregnancy shall be detected. Accurate detection is not always easy, for while a female may exhibit a number of signs which are strongly suggestive of pregnancy, a positive opinion can as a rule only be expressed by the recognition of the uterine changes characteristic of pregnancy or by the palpation of the foetus itself or its membranes. In some species, particularly the mare, changes which occur in the vagina and uterine cervix afford very strong evidence, as also does the presence of oestrogenic and gonadotrophic hormones in the urine and blood serum.

In those species which have an oestrous cycle of short duration and frequent recurrence, cessation of the cycle after coitus is the first indication that an animal is pregnant, and it is generally a reliable one. There are, however, marked variations in the intensity of the signs of heat, particularly in the cow and mare, and it is possible that the cycle has recurred but has been unobserved. Moreover, heat may be inhibited in non-pregnant animals due to hormone dysfunction. On the other hand, animals may show signs of heat and even accept service while pregnant. Such is often the case in the mare and cow.

Williams (1921) states that from 1-2 per cent. of pregnant cows show oestrus, and the author's experience confirms this. Bullard (1934) reported his observations on 9 animals which exhibited oestrus on one or more occasions during a single gestation and 1 which showed heat during two gestations. The number of periods in individuals varied from one to four. Out of a total of 15 heats during pregnancy, 3 occurred during the first 30 days, 11 during the next 100 days, and 1 during the last 30 days of pregnancy.

higher. Of the 44 additional matings, 14 were during the first 30 days of pregnancy, 14 between 31 and 100 days, and 16 from 101 to 232 days. Both cows and heifers were involved.

It is unknown whether ovulation with corpus luteum formation occurs at such heat periods in the cow. The evidence is against it. In a series of more than 100 random post-mortem pregnancy specimens at all stages of gestation, the author has only seen two corpora lutea with a single

fœtus on one occasion, and the assumption is that it was a case of twin ovulation and that one ovum perished. It is of interest to note in the mare, however, that ovulation during pregnancy occurs.

During pregnancy an animal tends to become sluggish in temperament and more tractable. There is also a tendency to fatten. Increase in bodyweight is an evident accompaniment of the growth of the fœtus and hypertrophy of the uterus and the mammary glands, and if regular weighing of the female is carried out it may serve in the later stages as evidence of pregnancy, but by this time other and more reliable indications are generally present. It is a matter, of course, that will be influenced by many factors and it is unlikely to give clear-cut evidence other than in the species having multiple young.

Increase in the volume of the abdomen is also an unreliable guide in animals except in the multiparous species. Moreover, in these care must be taken not to confuse pregnancy with diseased conditions which cause abdominal distension.

Detection of the fœtus, or fœtuses, through the abdominal wall is a method the facility of which varies not only in the different species but also with individuals. In the large, uniparous species the method is only of service in the later stages of gestation and individuals will be encountered in which the fœtus cannot be detected with certainty by ballottement even at term. In the dog and cat, however, the detection of changes in the uterus and later of the fœtuses themselves by palpation through the abdominal wall is the most reliable method. Progressive hypertrophy of the mammary glands and of the teats is reliable evidence of pregnancy. The period in gestation, however, at which it can first be detected varies in the different species. Moreover, in the animal which has been lactating throughout the greater part of the gestational period, its value as a guide is delayed until the terminal stages. Finally, in the bitch, in which subject œstrus is succeeded in the absence of pregnancy by pseudo-pregnancy changes, some mammary development may occur although the animal is not gravid.

In the bovine, palpation of the uterus per rectum is the most reliable method of pregnancy detection; while in the mare despite the development of other methods, rectal examination remains the standard clinical one.

THE MARE

For the early detection of pregnancy in the mare by rectal examination it is essential that the examiner shall have had experience of uterine palpation per rectum in non-pregnant animals. He must be familiar

with the "feel" of the uterine body beneath the fingers: be able to detect the cornua passing outwards and forwards and appreciate their size and tension when quiescent. He must also be able to locate the ovaries.

The restraint it is necessary to apply to the mare in order to carry out the examination will vary according to its individual temperament. In some it will be sufficient to raise a foreleg. More often, however, it is advisable to apply a twitch to the upper lip. In particularly nervous or treacherous mares it may be decided to work over a stable door or with a truss of hay behind the animal. The hand and arm should be well lubricated, introduced through the anus, and faeces removed from the rectum and the terminal portion of the colon. The lubricant used should be relatively non-irritating in order that straining shall not be provoked. As a rule, soap lather is employed although one of the non-irritating proprietary lubricants is preferable. Disinfectant solutions are best avoided. In the first instance the arm is introduced as far as the elbow only. Later, when the ovaries are being sought, it may be necessary to insert it farther. Finger-nails should be trimmed and great care must be taken not to apply too great pressure to the bowel wall, particularly during waves of peristalsis, for there is a risk that by doing so it will be injured.

Numerous writers have described the changes which occur in the pregnant uterus as detected by rectal examination; prominent among them being Dimock (1936) in America, Day (1939) in this country and Peters (1939) on the Continent. In preparing the description which follows the author has drawn on the writings of these observers and on his personal experience.

It is possible to detect pregnancy in a high percentage of mares at any time from the 30th day onwards, although during the 30-60 day period accurate detection is easier in primigravida and non-foaling mares than it is in those which have conceived at the foaling heat.

At the 30th day the gravid cornu, more often the right, is turgid and sausage-like in outline, and it contrasts strikingly with the flaccid uterine body and non-gravid horn. The beginner should locate the uterine cervix lying on the pelvic brim. A little in front of it the division of the body into the two horns will be felt. In the living subject the "bifurcation" is at right angles to the body and little difficulty should be experienced in picking it up with the fingers and then following each horn outwards and forwards.

TABLE 1

The Early Detection of Pregnancy in the Mare by Rectal Examination
(Day, F. T.)

Duration of pregnancy, days	Size of palpable embryonic mass	Position in the uterus
16	Bantam's egg.	Uterine cornu (often the right).
20	Golf ball.	" " " "
25	Pheasant's egg.	" " " "
30	Hen's egg.	" " " "
35	Tennis ball.	" " " "
40	Turkey's egg.	" " " "
45	Goose egg.	" " " "
50	Jaffa orange.	Occupying two-thirds of the cornu and one-third of the body.
60	Large Jaffa orange.	Occupying cornu and about half the body.
70	Ostrich egg.	
90	Child's football.	Filling the whole of the body and gravid cornu.

Data based on findings in Welsh ponies; other breeds will be relatively larger.

By the 45th day, in the riding mare, the embryonic mass forms a soft distension towards the apex of the cornu, oval rather than spherical in outline, and measuring about 6 cm. from side to side. The non-distended part of the horn behind it can generally be recognized. In locating the cornu the operator may find it an advantage to rotate his arm and search with the fingers in the outwards direction. In this way he tends to fix the cornu against the iliac shaft.

By the 60th day the localized cornual distension has attained a breadth of about 8 cm.—a large orange; it is still relatively soft to the touch and gentle pinching of the uterine wall may reveal the foetal membranes slipping through the fingers.

At 90 days distension involves the uterine body as well as a cornu. Its width is about 12.5 cm. and it lies somewhat transversely in front of and with its dorsal surface the same level as the pelvic brim. Care must be taken not to confuse a partially filled urinary bladder with the uterus during the 70-100 day period.

At 110 days the outline of the distended uterus resembles a rugby football and the organ has sunk a little below the pelvic brim. By gently tapping the dorsal surface with the fingers it may be possible to feel the foetus as it touches the uterine wall.

The 90–120 day period is the optimum time for the early detection of pregnancy by this method. Day (1940) points out that at this period the beginner may be confused between a distended uterus and an inflated condition of the large colon, but with a little experience the differences in tone which these organs present become readily distinguished.

By the 150th day appreciable distension of the uterine body tends to be lost owing to the uterus having sunk downwards and forwards into the abdomen and the fluids having gravitated with it. At this stage a positive diagnosis may be difficult to make, but the absence of a quiescent uterus and the inability to detect the ovaries in their normal position is almost conclusive evidence of pregnancy.

From 200 days onwards the size of the foetus is such that parts of it—limbs, head, ribs—can generally be palpated without difficulty.

The ovaries of the pregnant mare can be palpated with relative ease during the early stages. At first they are freely movable, but with the gradually increasing weight of the uterus and the consequent tensing of the mesovarium this mobility is progressively lost. Reduction in mobility is recognizable by the 90th day and is marked by the 120th. After this time it is unlikely that the ovaries will be detected, as they have been drawn downwards and forward beyond the reach of the hand. The size and shape of the ovary on the gravid side do not provide supporting evidence of pregnancy, as they do in the cow.

The Ovaries during Pregnancy

The presence of ovary-stimulating hormones in the blood serum of mares during certain well-defined periods of pregnancy makes a consideration of these organs of special interest. Cole, Howell and Hart (1931), who have investigated the subject, have divided the gestational period into four stages in relation to the changes which occur in the ovaries.

First Stage. This is characterized by the presence of one corpus luteum, the corpus luteum of pregnancy, in one of the ovaries and follicles of various sizes in both ovaries. It extends from conception until shortly after the 40th day. During this period the blood serum has no effect on the ovaries of immature rats in doses as great as 60 c.c.

Second Stage. In this period, which extends from about the 40th to the 150th day of pregnancy, there is progressive activity in the ovaries which is manifested by the continued formation of follicles and by marked luteinization. There may be as many as 10–15 follicles over

1 cm. forming corpora lutea or solid corpora lutea. Cole *et al.*, debating the question as to whether ovulation precedes this luteinization, state that in 8 out of 13 cases examined during this period, two distinct rupture points were visible and in one mare four rupture points were seen. They consider it to be logical to conclude therefrom that ovulation frequently occurs. It is during this period that the blood serum contains high concentrations of gonadotrophic hormone as demonstrated by the rat test.

Third Stage. The distinguishing feature of this period is the regression of the corpora lutea and large follicles are completely absent. It commences about the end of the 5th month and probably terminates at the end of the 7th. This stage coincides with the disappearance of ovary-stimulating substances from the serum.

Fourth Stage. During the terminal stages of pregnancy only minute vestiges of the corpora lutea exist and only rarely are follicles larger than 1 cm. found.

Reference has already been made, when discussing the œstrous cycle, to the greater frequency with which ovulation occurs from the left ovary than the right in the mare, yet several observers (Kedrov, 1939; Day, 1940; Amoroso and Rowlands, 1948; and Hancock, 1948) have noted that the foetus generally occupies the right uterine horn.

Amoroso and Rowlands quote 15 single pregnancies of which 13 were implanted in the right horn and in only 4 of these could it be certain that ovulation at the time of mating occurred in the right ovary alone. In another 8 it was established that ovulation took place in the left ovary. Of 5 twin pregnancies, expulsion of both ova was from the left ovary in 2, and foetal migration occurred in both cases. In one a foetus was implanted in each horn and in the other the right horn contained both. Hancock found 15 of 19 single pregnancies to be in the right cornua. Day has reported the migration of foetuses in both directions within the uterus.

There has been some doubt as to whether the mare in fact ovulates during pregnancy. Amoroso and Rowlands (1948) have provided proof on this point. They have recovered one or more ova from the oviducts of 9 out of 14 mares which have been examined post-mortem when 46-73 days pregnant. The ovaries of all 14 mares contained one or more fully formed corpora lutea, but in none (with the possible exception of the mare killed on the 46th day) could the primary corpus luteum of pregnancy be recognized.

The Vagina

Day and Miller (1940) have studied the vagina of the mare during pregnancy. Commencing as early as the 30th day the mucous membrane becomes very much paler in colour than it is at any time during the oestrous cycle. It presents a pearly appearance covered by a fine network of small blood-vessels. A little later the vessels become obscured and the mucosa appears uniformly blanched and pale. Introduction of a speculum may be difficult, for there is no tendency for the vagina to balloon and the walls, which seem to be quite dry, separate with difficulty. The cervix and the external os become obscured by a sticky, opaque secretion. The cervix is turned away from the midline; usually downwards or to one side, but occasionally upwards. Palpation reveals the mucosa to be covered by a copious, sticky secretion, greyish-yellow or pinkish in colour. The amount and stickiness of the secretion increase as pregnancy advances. Confusion may arise when examining mares in anæstrus in the winter, when the vagina is also dry and blanched, but the amount of mucus present is much less than in pregnancy.

In the later stages of pregnancy in the mare it is generally possible to palpate parts of the foetus through the anterior vaginal wall, and as the animal generally resents vaginal interference less than rectal, this should be the first examination performed.

The Mammary Glands

Hypertrophy of the mammary glands is seldom appreciable until the last 21 days of pregnancy. It is generally less marked in primigravida than in multigravida. Tumefaction of the teats occurs during the last 3 or 4 days. Œdema of the ventral abdominal wall is sometimes present in the terminal stages. Just before foaling the mammary secretion may exude from the teats and coagulate about the orifices, forming a pearly bead. This process is known as "*waxing*" and is regarded as a reliable indication of approaching parturition. The duration of waxing varies. In some mares it may be seen as early as 48 hours before foaling; in others for 1-2 hours only. Multigravid mares may show no signs of wax; in fact, they may commence to lactate as early as 48 hours before foaling—milk squirting from the teats as they move about.

Duration of Gestation

There is considerable variation in the normal duration of gestation in the mare. Fleming-Craig (1930) quote numerous Continental observa-

tions which give a range of 307–420 days, with an average of between 335 and 346 days. Periods over 400 days, however, must be regarded as very exceptional, although relatively short periods in the 310-day region are not uncommon.

In recent observations by Tutt (1944) on 68 English thoroughbred mares, the average in 1942 was 340 days, with a range of 309–361; and in 1943 the average was 354 days, with a range of 325–381.

It is generally accepted that gestation tends to be a little longer with colt than with filly foals.

English experience does not confirm Williams's (1940) statement that foals in which the gestational period approximates 365 days are usually ill from sepsis, nor does it indicate that there is a higher mortality among foals born after the shorter gestational periods.

Biological Tests

Blood Serum. The presence of a gonadotrophic factor in the blood serum of the pregnant mare was first discovered by Cole and Hart (1930). Since that time it has become known as pregnant mare's serum hormone, or "P.M.S." It is first found between the 37th and 42nd days of pregnancy and reaches its maximum between the 50th and 80th days, although peak concentrations may persist to the 100th day. From this point it gradually diminishes until it is absent after the 150th day.

The presence of this hormone is demonstrated by the stimulation of ovarian activity in immature rats or mice, and it serves as a means of pregnancy diagnosis during the 45–100 day period of pregnancy.

Miller and Day (1938) have described the mouse test in detail.

30–40 c.c. of the mare's blood is allowed to coagulate and the serum expressed in about 24 hours. A certain amount of hæmolysis may have occurred due to shaking during transit, but this does not appreciably affect results. The serum is stored at 4° C. and injected in quantities of 0.25 ml. (c.c.) twice daily for 2 days into each of four or five test mice about 3½ weeks old. Some 24–30 hours after the last injection the ovaries and uteri of the mice are examined post-mortem. In a negative case the uterus is small and undeveloped, the horns being little thicker than ordinary sewing thread; the ovaries are small and inactive, each being a uniform pale pink in colour and hardly as large as a hemp seed. In positive cases the uterus is generally turgid and swollen to five times its normal size. It may be somewhat ballooned with fluid. The ovaries show a variety of changes, depending on the concentration of the hormone and the degree of responsiveness of the mouse. In all cases they are swollen and congested. The weaker positive sera from early pregnancy produce a crop of ripe follicles in each or at least one ovary, while the stronger samples produce a crop of hæmorrhagic follicles or of corpora lutea. Hæmorrhagic follicles appear as dark-red or black spots numbering from 2–3 to as many as 7–8 in each ovary. In positive cases also the vagina and vulva

are markedly swollen, and in some a tentative diagnosis can be made by examination of the external genitals. It is inadvisable, however, to base a diagnosis on this feature only, since a considerable number of positive reactions are not accompanied by marked vulval swelling and congestion.

These workers have found the test to be approximately 90 per cent. accurate for the diagnosis of pregnancy between the 60th and 100th day (see Table 2).

Urine. The presence of oestrogenic hormones in the urine of pregnant females was first discovered by Aschheim and Zondek (1927). The pregnant mare generally commences to excrete oestrone in her urine in appreciable quantities at about the 75th day after conception; it may be delayed until the 85th-90th day, while in exceptional cases the 120th day may be reached before a mare's urine contains sufficient quantities to give a positive reaction. From this time the amount increases until the 280th-290th day, after which it decreases until during the last month of pregnancy the amount may be very small.

The Mouse Test (Allen and Doisey *et al.*, 1924). Ovariectomized mice are used and a positive reaction comprises the provocation in the vaginal epithelium of the changes which characterize oestrus. Miller (1938) has described the test as follows:

TABLE 2
*A Comparison of the Blood, Mucin and Urine (Mouse) Test for the Diagnosis of Pregnancy in the Mare (Day, F. T., and Miller, W. C.)
 Seasons 1937 and 1938. Number of Mares examined by Each Test and Percentage Accuracy of Results obtained*

Stage of Pregnancy, in days	Blood Test (Mouse)			Mucin Test			Urine Test (Mouse)		
	No. Correct	No. Wrong	Percentage Accuracy	No. Correct	No. Wrong	Percentage Accuracy	No. Correct	No. Wrong	Percentage Accuracy
20-39	21	23	47.7	83	24	77.6	17	19	47.2
40-49	30	6	83.3	54	14	79.4	8	12	40.0
50-59	39	7	84.8	66	12	84.6	8	15	34.7
60-69	34	1	97.1	56	12	82.4	5	7	41.7
70-79	40	3	93.0	75	4	94.9	6	12	33.3
80-89	28	5	84.8	54	5	91.5	10	5	66.6
90-99	31	5	86.1	62	2	96.9	7	15	33.6
100-120	42	10	80.8	90	5	94.7	17	8	68.0
Over 120	29	27	51.8	141	5	96.6	29	7	80.5

TABLE 3
*Comparative Reliability of the Biological, Cuboni and Phenolsulphonic Acid Test for Pregnancy in Urine of Mares obtained after the 120th
 day of the Gestation Period. (Mayer, D. T.)*

Samples	Foaling Record	Biological Method (Rat)			Cuboni Method			Phenolsulphonic Acid Method		
		No. +	No. -	Percentage Correct	No. +	No. -	Percentage Correct	No. +	No. -	Percentage Correct
66	All foaled	66	0	100	66	0	100	66	0	100
28	None foaled	4	24	85.7	1	27	96.4	1	27	96.4

accompanied by marked vulval swelling and congestion.

These workers have found the test to be approximately 90 per cent. accurate for the diagnosis of pregnancy between the 60th and 100th day (see Table 2).

Urine. The presence of oestrogenic hormones in the urine of pregnant females was first discovered by Aschheim and Zondek (1927). The pregnant mare generally commences to excrete oestrone in her urine in appreciable quantities at about the 75th day after conception; it may be delayed until the 85th-90th day, while in exceptional cases the 120th day may be reached before a mare's urine contains sufficient quantities to give a positive reaction. From this time the amount increases until the 280th-290th day, after which it decreases until during the last month of pregnancy the amount may be very small.

The Mouse Test (Allen and Doisey *et al.*, 1924). Ovariectomized mice are used and a positive reaction comprises the provocation in the vaginal epithelium of the changes which characterize oestrus. Miller (1938) has described the test as follows:

Young female mice are spayed, and they are ready for the purposes of the test 2-3 weeks after operation. They can be used for successive tests provided 2-3 weeks elapse between them. The urine sample should be a "true" one taken from the mare in her normal resting state. Prior to use the urine is treated to overcome its toxicity to mice.

Sulpho-salicylic acid (1 g. per 25 c.c.) is added until all reaction between it and the urine ceases. The urine is then allowed to stand for $\frac{1}{2}$ hour. By this treatment, protein is precipitated, bacterial activity is inhibited and some degree of detoxication occurs. Most equine urine is strongly alkaline, especially that obtained from

volume of distilled water. In this form it is ready for use.

Four mice of about equal size and age are used. 0.5 c.c. of the prepared urine is injected subcutaneously twice daily for 3 days. 1-2 days after the last injection the test is "read." Using a wire loop, smears are made from the anterior vagina of each mouse and these are stained by the usual Giemsa technique. Under the influence of oestrone, the normally small, round, nucleated epithelial cells are converted into large, angulated, cornified, non-nucleated cells, and it is on the presence of the latter that a positive diagnosis is based.

At the 120th day the test is about 80 per cent. accurate, errors being chiefly in negative results (Table 2). For information on the factors which cause erroneous results the reader is referred to Miller's original writings.

TABLE 2
*A Comparison of the Blood, Mucin and Urine (Mouse) Test for the Diagnosis of Pregnancy in the Mare (Day, F. T., and Miller, W. C.)
 Seasons 1937 and 1938. Number of Mares examined by Each Test and Percentage Accuracy of Results obtained*

Stage of Pregnancy, in days	Blood Test (Mouse)			Mucin Test			Urine Test (Mouse)		
	No. Correct	No. Wrong	Percentage Accuracy	No. Correct	No. Wrong	Percentage Accuracy	No. Correct	No. Wrong	Percentage Accuracy
20-39	21	23	47.7	83	24	77.6	17	19	47.2
40-49	30	6	83.3	54	14	79.4	8	12	40.0
50-59	39	7	84.8	66	12	84.6	8	15	34.7
60-69	34	1	97.1	56	12	82.4	5	7	41.7
70-79	40	3	93.0	75	4	94.9	6	12	33.3
80-89	28	5	84.8	54	5	91.5	10	5	66.6
90-99	31	5	86.1	62	2	96.9	7	15	33.6
100-120	42	10	80.8	90	5	94.7	17	8	68.0
Over 120	29	27	51.8	141	5	96.6	29	7	80.5

TABLE 3
Comparative Reliability of the Biological, Cuboni and Phenolsulphonic Acid Test for Pregnancy in Urine of Mares obtained after the 120th day of the Gestation Period. (Mayer, D. T.)

Samples	Foaling Record	Biological Method (Rat)			Cuboni Method			Phenolsulphonic Acid Method		
		No. +	No. -	Percentage Correct	No. +	No. -	Percentage Correct	No. +	No. -	Percentage Correct
66	All foaled	66	0	100	66	0	100	66	0	100
28	None foaled	4	24	85.7	1	27	96.4	1	27	96.4

Chemical Tests

Cuboni Test. Cuboni (1937) first developed a chemical test for the detection of oestrogenic hormone in mare pregnancy urine (see Table 3).

A mixture of 15 c.c. of urine and 3 c.c. of concentrated hydrochloric acid is heated in a water-bath at boiling-point for 10 minutes. The mixture is cooled, poured into a separating funnel, 18 c.c. of benzol added and the whole shaken. The benzol layer is collected, poured into 10 c.c. of concentrated sulphuric acid and heated in a water-bath at 80° C. for 5 minutes. The mixture is then cooled again. In the case of pregnant animals a green fluorescence develops, while with the urine of non-pregnant mares no such fluorescence occurs. A positive reaction first appears at about the 120th day of the gestational period.

Phenolsulphonic Acid Test. This test was devised by Mayer (1944) and is based on the Kober colorimetric test for oestrogens (Table 3).

The hydrolysis of the conjugated estrogens is accomplished by slowly adding 3 c.c. of concentrated HCl to 51 c.c. of a specimen of mare's urine in a Pyrex test-tube and heating in a boiling water-bath for 10 minutes. This is a modification of the hydrolysis technique recommended by Smith and Smith. Following the hydrolysis, the urine is cooled to 15° C. in an ice water-bath to precipitate urinary pigments and substances formed during hydrolysis which mask the final red colour. The precipitated substances are removed by filtration and the amber-coloured filtrate collected in a separating funnel.

The filtrate in the funnel is extracted twice with 20 c.c. and once with 10 c.c. of peroxide-free ether to remove the estrogens. The combined ether extracts are then shaken in the separating funnel with 100-c.c. portions of 2 per cent. Na_2CO_3 solution until the carbonate washes are colourless (usually three or more washes are required). The carbonate washes are followed by a final wash with 20 c.c. of distilled water.

The ether extract at this stage is nearly colourless, but in many instances may contain a purplish-red pigment. The washed ether is now extracted with three 15-c.c. portions of N.10 NaOH, in which the estrogens are soluble but in which many of the ether-soluble, contaminating substances do not dissolve. The NaOH extracted ether is washed once with 15 c.c. of distilled water. The water wash and three NaOH extracts are combined, and 25 per cent. H_2SO_4 added until the solution is acid to congo-red paper. The combined acidified N.10 NaOH extracts and water wash are then extracted with ether to remove estrogens as previously described for the filtrate of the urinary hydrolysate. The 20 per cent. Na_2CO_3 and water washes are also made if the ether extracts are brown.

The three ether extracts of the acidified NaOH solution are poured into a clean, dry 215-c.c. Erlenmeyer flask, preventing, however, the inclusion of water adhering to the separating funnel. After the evaporation of the ether in a water bath, 3 c.c. of a specially prepared phenolsulphonic acid reagent are added and the contents of the flask heated for 5 minutes in a boiling water-bath. The flask is immediately plunged into an ice water-bath and cooled. To the cooled mixture, 3 c.c. of a 5 per cent. H_2SO_4 solution are added, the flask again heated for a 3-minute period, cooled, and diluted to 10 c.c. by the addition of 4 c.c. of water or 5 per cent. H_2SO_4 .

The formation of a pink to cherry-red colour, the intensity of the colour depending upon the stage of pregnancy when the urine specimen was collected,

constitutes a positive test for pregnancy. If the procedure has been carefully followed, no interfering colours should appear. The addition of a few drops of Superroxal (30 per cent. hydrogen peroxide) and warming, causes all the colour produced by the conjugation reaction between estrogens and the reagent to disappear, but does not affect "nonestrogen" colours. The H_2O_2 reaction, thus, can be used as a confirmatory test.

The non-pregnant state is indicated when the residue of a urine extract does not form the red colour with the reagent.

Mucin Test

Attention has already been directed to the characteristic physical changes which occur in the vaginal mucus of the mare during pregnancy. Kurosawa (1931) has described microscopical examination of this mucus as a means of pregnancy diagnosis, and the method has been developed in this country by Miller (1938).

A little of the tenacious mucus is obtained from the region of the external os of the uterine cervix, either manually or using a vaginal speculum and swab, and thin smears made on several glass slides. After fixing with alcohol and allowing to dry, the smear is stained for 20 minutes with Delafield's hæmatoxylin and then washed. The affinity of the mucus for stain is much greater in the pregnant than non-pregnant mare and in positive cases the smear will appear dark blue in colour. When examined under the 3rds objective distinct globules of mucin are seen in the thinner parts of the smear. Having found a field where there is a large number of cells, examination should be continued with the 4th objective. If the mare is pregnant, a number of "pregnancy cells" will be observed. These are columnar epithelial cells which have the appearance of bent tin-tacks, the dark staining nucleus being situated a little behind the point. The cytoplasm of these cells stains very faintly only. Quite a number of other cells are also present, but if there are globules of mucin, a number of pregnancy cells and a smaller proportion of other cells, then the mare is pregnant.

Miller and Day have recorded their results of the test, which show an ascending accuracy of from 77.6 per cent. in the 20-40 day period to an average of 94.8 per cent. from the 70th day onwards (Table 2).

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CHAPTER 3 -

PREGNANCY IN THE COW

RECTAL examination is generally accepted to be the most reliable method of detecting pregnancy in the cow, particularly in the early and mid-gestational periods. Positive evidence is afforded by the detection of the characteristic changes which the uterus and the uterine arteries undergo during pregnancy and by palpation of the fœtus itself or its membranes. Useful supporting evidence is obtained by recognition of the persistence of a fully developed corpus luteum in one ovary over a period of several months. Negative evidence is afforded by the detection of a quiescent uterus and, when opportunity occurs for several examinations, the variations in the ovaries according to the times in the œstrous cycle at which those examinations are made. (Uterine enlargement, absence of œstrus and the persistence of a corpus luteum, may also occur in certain pathological conditions.) The facility or otherwise with which a diagnosis can be made will depend on several factors, the most important of which are :

- (a) The stage in gestation at which examination is made.
- (b) The degree of resistance, voluntary or involuntary, offered by the animal to examination.
- (c) The degree of parity of the animal.

It will readily be understood that reliably to assess the state of affairs in the uterus and ovaries by a method so prone to error as rectal palpation it is essential that the person conducting the examination shall have an exact knowledge of the anatomy, particularly as regards size and position, and the physiology of the uterus and ovaries, not only during the various stages of gestation, but during the different phases of the œstrous cycle also.

The Ovaries

In the cow the corpus luteum of pregnancy (corpus luteum verum) persists at its maximum size throughout the whole of the period of gestation. Fundamentally it is indistinguishable from the fully developed corpus luteum of œstrus, but there are certain features by which its

persistence can be recognized when examined on the post-mortem-room table. The chief is that the protrusion of the structure from the surface of the ovary is less marked and the epithelium over it is white and scarred. The corpus luteum of œstrus often contains a central lacuna, whereas during pregnancy this becomes filled by connective tissue. It is considered by some that the corpus luteum verum is larger than that of œstrus. The writer's series indicates that if this is the case it is too slight to be of significance, and moreover that there are considerable variations in the weights of pregnancy corpora lutea in individuals (3.9-7.5 g.) which bear no relationship to the duration of pregnancy. The colour of the corpus luteum of pregnancy, however, differs somewhat from that of diœstrus. There is a wider range from yellow-orange-light brown and the appearance of the luteal tissue is duller.

BOVINE OVARIES DURING PREGNANCY, FIGS. 22-31

(Natural size)

Throughout the book, sketches of bovine ovaries are of a section from the attached to the free border through the poles. In those cases in which this section did not pass through the greatest dimension of the significant corpora lutea or the largest follicle, the sketch has been made as though it did so but without materially altering the size of the ovary.

When it is possible to examine the animal, first between the 10th and 17th days after service, again on the 22nd, and again about the 40th,



FIG. 22.—35 DAYS.
F.B.L. 1.6 cm.; C.L.V. yellow.



FIG. 23.—48 DAYS.
F.B.L. 3.4 cm.; C.L.V. orange.

L.

R.

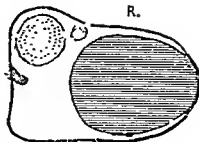


FIG. 24.—70 DAYS.
F.B.L. 6.3 cm.; C.L.V. yellow-orange.

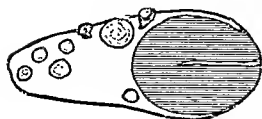


FIG. 25.—100 DAYS.
F.B.L. 16 cm.; C.L.V. yellow-brown.

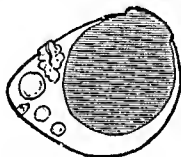


FIG. 26.—120 DAYS.
F.B.L. 25 cm.; C.L.V. orange.

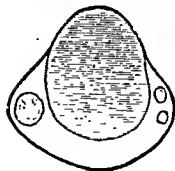


FIG. 27.—190 DAYS.
C.L.V. orange.

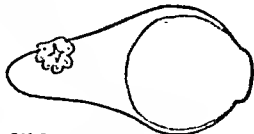


FIG. 28.—245 DAYS.
C.L.V. yellow-orange; no visible follicles.



FIG. 29.—AT PARTURITION.
C.L.V. orange; no visible follicles.



FIG. 30.—11 DAYS AFTER PARTURITION.
Regressing C.L., dark brown, shrunk.



FIG. 31.—4 DAYS AFTER ABORTION, 6 MONTHS' GESTATION.
Regressing C.L., light brown.

and it is found that the same ovary remains uniformly larger than the other throughout, it is strong evidence that the animal is pregnant on that side. The absence of signs of heat during that period is supporting evidence. Theoretically it should be possible to establish whether or not the corpus luteum is persisting on the 20th-22nd day, for if the animal is not pregnant and subsequent ovulation is about to occur or has occurred in the opposite ovary, then the original ovary will be considerably reduced in size. Errors, however, may occur if œstrus has been unobserved and the second ovulation has occurred on the same side, when that ovary will contain the newly forming and the recently regressing corpus luteum.

As pregnancy advances the position of the ovaries changes. Their location, however, in non-gravid animals is not constant. In heifers and young cows they are generally situated on each side of and slightly below the conjoined cornua at the level of the pelvic brim. They may lie in the pelvic cavity. In multiparous animals they are often situated in the abdominal cavity, 2-3 inches in front of the pelvis, where their

detection is more difficult. Consequent on the increase in the weight of the uterus and hypertrophy of the ovarian and uterine ligaments, the ovaries pass deeper and deeper in the abdominal cavity as pregnancy advances. From the 5th month onwards the weight and size of the uterus is such that it sinks down into the abdomen to rest on the abdominal floor. Hammond (1927) found the weight of the uterus and its contents in primigravida at 5 months to be 48.4 kg. (106½ lb.). Provided that the animal is comparatively easy to examine, it is generally possible to palpate the ovaries with reasonable certainty up to the 100th day, by which time in heifers the one on the gravid side is about 3–4 inches in front of and slightly below the pelvic brim, and that on the non-gravid side a little nearer the pelvis. In occasional cases both ovaries may be detected as late as the 150th day, although by this time there is a risk that they will be confused with cotyledons. In the later stages of pregnancy it is not so much that they are beyond the reach of the hand as that of one's inability to depress the colon sufficiently deeply into the abdomen to locate them.

The Uterus

During the early stages detection of an increase in size of the uterus affords strong evidence, but the recognition of these changes necessitates an appreciation of the size of the quiescent uterus in subjects of varying ages and parity, the quantities of fluid present in the respective foetal sacs and the disposition of those sacs in the uterus (Tables 4 and 5).

The volume of the foetal fluids increases rapidly during the early stages until the 5–6 month period, after which it remains fairly constant. Nevertheless there is a wide range of individual variation both in the total quantity and that contained in the respective sacs.

Average figures for the total volume are as follows:

At 2 months	..	..	300 c.c.
„ 3 „	..	..	1 litre
„ 4 „	..	..	3 litres
„ 5 „	..	..	7 „

At 28 days' pregnancy the amniotic sac is spherical in outline and about 2 cm. in diameter. It occupies the free portion of the gravid horn. The allantoic sac is about 18 cm. long, but the amount of fluid in it is very small and its width is negligible. It occupies almost the whole of the gravid cornu. At this stage the embryo is 0.8 cm. long—a quite inappreciable size.

At 35 days foetal bodylength is 1.8 cm. and the diameter of the spherical amniotic sac 3 cm. They still occupy the free part of the cornu. The conjoined portions of the cornua and the free portion of the non-gravid cornu are not appreciably changed. It is possible, particularly

TABLE 4
Quantities of Foetal Fluids

Approx. Period of Gestation, days	Foetal Body-length, cm.	Volume of Fluids		
		Allantoic, c.c.	Amniotic, c.c.	Total, c.c.
40	2.0	50	25	75
50	4.6	120	lost	—
60	6.5	260	50	310
60	6.5	350	60	410
70	9.5	110	173	283
70	11.0	250	200	450
70	12.0	400	250	650
75	13.0	440	260	700
80	14.0	420	340	760
100	20.0	—	—	2020
100	21.0	585	1370	1955
105	22.0	514	1155	1669
110	25.0	1600	1500	3100
120	30.0	1230	2210	3440
125	32.0	1300	2500	3800
*140	39.0	—	—	6510 g.
†140	—	3300	4300	7600
150	42.0	9140	1700	9840

* Hammond (1927).

† Bergmann (1921).

TABLE 5
Uterine Dimensions (Non-gravid Organ)

	Unbred Heifer, cm.	Multiparous Cow, cm. (average)
Width of conjoined cornua immediately anterior to cervix.	2.5	4.0
Width of each cornu at external bifurcation.	2.0	3.5
Length of externally connected parts of cornua.	9.0	14.0
Length of free portions of cornua ..	15.0	20.0
Thickness of wall of cornu	0.5	1.2
Length of cervix	5.0	10.0
Width of cervix	3.0	5.0

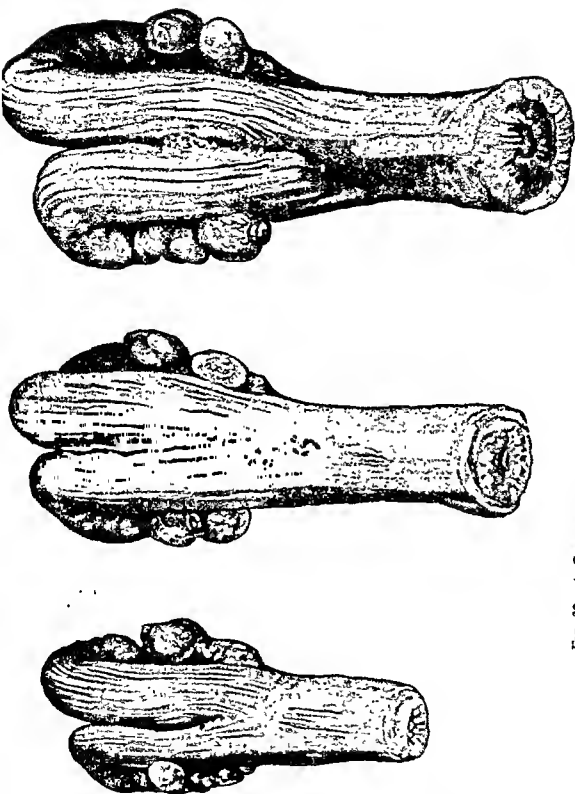


FIG. 32.—A COMPARISON OF THE SIZES OF THE BOVINE UTERUS. A first-calf heifer, a second calver and an aged multigravid animal.

in a heifer easy of examination, that the distension in the free part of the gravid cornu will be detected. McWilliam (1943) has aptly described it as feeling like a soft-shelled hen's egg.

At 60 days foetal crown-rump length is approximately 6 cm. The amniotic sac is oval and tense, having a transverse measurement of about 5 cm. This causes the free part of the gravid horn to be distended to width of about 6.5 cm., as compared with 2-3 cm. in the quiescent stage in the heifer and young cow. In such subjects this distension may be recognized.

American and English observers consider detection of the foetal membranes to be a valuable diagnostic guide during the 35-50 day period. The free part of the gravid cornu (its side is checked by the corpus luteum in the ovary) is gently pinched through the relaxed rectal wall and the sensation of the membranes slipping between the thumb and fingers can be detected. In the writer's view the value of the method has been overstressed. It is most useful in heifers, but many cases, particularly multigravida, will be encountered in which it fails.

At 80 days the foetus measures 11 cm. and the total quantity of fluid is about a quart. Distension of the free part of the gravid horn varies from 7-10 cm., while that of the conjoined part is but little greater than normal. The greater length of the gravid horn can often be detected.

By 90 days uterine distension is such that it can in the great majority of cases be detected with accuracy. The conjoined cornua are tense, the gravid one having a width of about 9.0 cm. and the non-gravid about 4.5 cm. In most individuals the organ is still high up at the pelvic brim and it is generally possible to pass the hand well over the curvature of the distended horn, but in some multigravid cows the uterus lies in the abdomen and to palpate it effectively it is necessary to retract the organ by the application of vulsellum forceps to the cervix. Sometimes it is possible to detect the foetus at this stage. Tapping of the distended cornu with the fingers may reveal the foetus rather like a piece of wood floating in the fluid beneath. By gently squeezing the uterus one may be able to pick up the foetus. Its bodylength is about 15 cm.

By the 4th month the uterus sinks below the pelvic brim and distension is less easy to recognize, as the fluid gravitates towards the extremities of the cornua. The cervix lies on the pelvic brim.

Henceforth, the foetus itself, the enlarged cotyledons and the hypertrophied uterine arteries are the structures searched for.

The Fœtus

Several workers (Hammond, 1927; Winter, Grein and Comstock, 1942) have recorded fœtal body-lengths (Crown-Rump) during the various stages of pregnancy. Data have been collected chiefly from pregnant heifers, and thus allowance must be made for the greater size of the fœtus in cows, particularly in the later periods of pregnancy.

Average figures are:

Pregnancy				Fœtal body-length	
1 month	..	..	..	0.8 cm.	($\frac{1}{3}$ inch)
2 months	..	..	..	6	„ (2 $\frac{1}{2}$ inches)
3	„	..	..	15	„ (6 „)
4	„	..	..	28	„ (11 „)
5	„	..	..	40	„ (16 „)
6	„	..	..	52	„ (21 „)
7	„	..	..	70	„ (28 „)
8	„	..	..	80	„ (32 „)
9	„	..	..	90	„ (36 „)

The fœtal bulk in relation to these body-lengths will be appreciated.

During the period 120–160 days it will be possible to palpate the fœtus in more than 50 per cent. of cases. The presented extremity will lie within reach in front of and below the pelvic brim. In some cases the fœtus may be touched transiently at the commencement of examination and then sink into the depths of the uterus beyond reach. Similarly, if a series of an examination of an individual is made at this period, the fœtus may be detected at some and not at others.

Between 5 $\frac{1}{2}$ and 7 $\frac{1}{2}$ months the fœtus is detected less often than during the previous period. The writer would put it at 40–50 per cent. In favourable cases the fœtal head and/or flexed limbs are palpated just anterior to the pelvic brim. Often, touching of the fœtus provokes reflex movement in it. But in those cases in which the fœtus cannot be palpated at this stage or the previous one there is plentiful evidence of pregnancy present—the absence of a quiescent uterus and ovaries; the tension on the cervix at the pelvic brim; the detection of cotyledons and hypertrophy of the uterine arteries. Moreover, in some cases the fœtus can be palpated through the abdominal wall from 6 $\frac{1}{2}$ months onwards.

From 7 $\frac{1}{2}$ months to the end of gestation the fœtus will in the majority of cases be detected readily. Again, however, cases will be encountered, especially in deep-bellied, multiparous cows in which the fœtus cannot be detected, at any rate on a single examination, even to term.

The Non-Gravid Cornu

The extent to which the allanto-chorionic sac occupies the non-gravid horn varies greatly. In the great majority of bovine pregnancies the sac occupies some part of it; in some it extends to the apex, in others the posterior two-thirds or one half only is occupied, while in exceptional cases the non-gravid horn is entirely unoccupied by foetal membranes. In the majority of cases also the non-gravid horn plays its part in placentation and its cotyledons hypertrophy, although the degree of cotyledonary enlargement is not as great as that of the pregnant horn. Occasionally the non-gravid horn, although occupied by the allantois-chorion, plays no part in placentation and its cotyledons remain undeveloped. In such cases, and also in those in which the non-gravid horn is unoccupied, the cotyledons in the gravid horn, particularly those in the region of the foetal trunk, become grossly hypertrophied and may at the time of parturition be as large as 8×12 cm.

The Cotyledons

Detection of the hypertrophied cotyledons variations occur in their size at the various stages of pregnancy in different individuals. This is probably due to differences in number. Again there is variation throughout the same uterus. Those situated about the middle of the gravid cornu are larger than those of the extremities, while those in the non-gravid horn are smaller than those in the gravid one. (Occasionally there is no placentation in the non-gravid horn.) Cotyledons first become recognizable by rectal palpation between the 4th and 5th months. They are felt in the mid-line, about 3-4 inches in front of and slightly below the pelvic brim, by pressing the fingers firmly into the uterus and stroking backwards or by squeezing it. Generally three or four about the size of walnuts can be detected. As pregnancy continues they become progressively larger, until in the terminal stages they may be larger than hen's eggs.

The Uterine Arteries

Evidence of pregnancy is afforded by hypertrophy of the uterine arteries and a characteristic change in their pulse wave. The latter ceases to be the usual pulse and instead becomes a "thrill" or tremor. There is considerable variation in the time at which the change can first be felt, and also when it becomes continuous. The earliest the writer has been able to detect it is the 86th day. During the period 100-175 days cases will frequently be met which "thrill" at first but later pulsate.

It is probable that the degree of pressure applied to the artery influences the feeling imparted to the fingers; light pressure detects a "thrill," whereas a pulse wave is apparent to heavy pressure. The "thrill" generally becomes continuous after the 175th day, although cases will be met in which there is distinct pulsation as late as the 200th day. During the terminal stages of gestation the uterine arteries become greatly hypertrophied and tortuous. The middle uterine arteries can be distinctly felt, the thickness of a pencil, with a continuous, tremor-like pulse, laterally situated an inch or so in front of the anterior border of the shaft ilium. (The middle uterine arteries are distinguished from the obturator arteries by their comparative mobility. They lie in the broad ligaments, whereas the positions of the latter are fixed.)

The Pregnant Side

It is generally accepted that in the dairy cow pregnancy more often occurs in the right uterine cornu than the left. In the author's series of post-mortem specimens the proportion has been 60 right to 40 left, and in all cases the corpus luteum of pregnancy has been in the ovary on the same side as the gravid horn. In one case a corpus luteum of normal size was present in each ovary and a single foetus was present in the right horn. Erdheim (1942) in America, has recorded valuable data on this matter. In a series of 1506 post-mortem examinations on pregnant dairy cows, the foetus occupied the right horn in 1015 (67·4 per cent.) cases and the left in 474 (31·4 per cent.), while twins were present in 17 (1·1 per cent.). In 2318 pregnant beef cows examined, however, the side incidence was approximately equal; right 1178 (50·8 per cent.), left 1121 (48·3 per cent.) and twins 19 (0·9 per cent.). No explanations for these variations is yet forthcoming.

Twinning

The incidence of twinning in dairy cows is generally put at about 2 per cent. In the majority of cases one corpus luteum is to be found in each ovary and a foetus in each cornu. Not infrequently, however, twin corpora lutea are found in a single ovary while gestation is bicornual. In a few cases both foetuses develop in one horn. The author has not encountered a case of identical twinning, viz. a single corpus luteum with two developing foetuses, nor has he encountered a case in which the foetus was developing in the cornu opposite to the ovary containing the single corpus luteum, although he has seen this condition in the ewe. Erdheim's records are of interest in these connections. In 25 pairs of

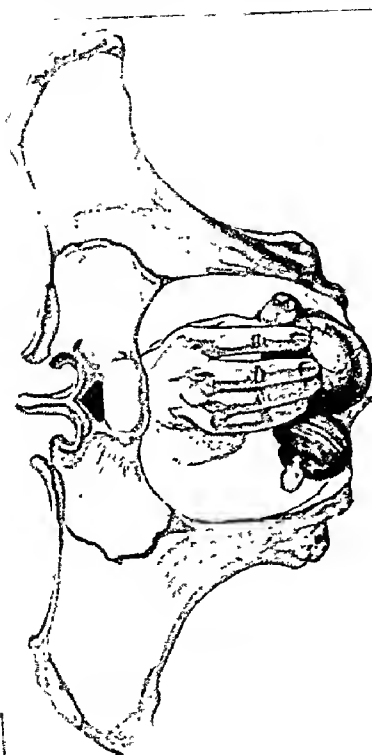
twins, 5 were unilateral. In all but one case there was a corpus luteum present in each ovary. In the exception (beef breed) bilateral twinning was present with a single corpus luteum in the left ovary (sex of twins not stated). In one case of single pregnancy, the corpus luteum was in the left ovary and the foetus occupied the right horn.

It is convenient at this point to record the findings of Curson (1934) in the ewe. In 36 single pregnancies, the position was normal in 34, in that the foetus occupied the cornu on the same side as the ovary containing the corpus luteum (19 right and 15 left), while in the remaining 2 the corpus luteum was in the left ovary and the foetus was in the right horn. In 5 cases of twinning the usual condition of one corpus luteum in each ovary and one foetus in each horn was present in 3. In the other 2, both corpora lutea were present in the left ovary and a foetus occupied each horn.

Method of Rectal Examination

The operator should wear "gum" boots and a long rubber or oiled-silk gown which fastens at the back. The sleeves should be short and fit the arm tightly by elastic. When a number of animals are to be examined an assistant is required to write down the findings as they are made. It is quite impossible to memorize findings after the examination of two or three animals. The assistant will also help in restraining a fractious animal, particularly during the passage of the hands through the anus, by pressing her quarters against the partition of the stall. He may also reduce the degree of straining by pinching the animal's back. If possible, the examiner should stand on the same level as the cow. When dealing with large cows in a byre in which it is necessary for him to stand in a deep drain, he tends quickly to tire. The right hand and arm are lubricated with water and soap; liquid paraffin or the proprietary lubricants possess no special advantages and they are more difficult to remove. The hand is passed conewise through the anus into the rectum. At the commencement of the examination the arm should not be introduced beyond the middle of the forearm, for it is the interior of the pelvis it is first desired to palpate; later, when it is desired to explore the abdominal cavity in front of the pelvic brim, the hand and arm are fully introduced. As a rule introduction of the hand provokes defecation. This is an advantage. The hand should not be suddenly withdrawn or the defecation reflex may cease, but the examiner should allow it partially to be forced out of the anus by the peristaltic wave. In some cases detailed examination is most difficult because of the almost continuous peristalsis which the presence of the

backwards. In this way a nodular object will be felt. Having located an ovary, an opportunity is awaited when the bowel is relaxed to pick it



Uterus gravid 70 days.

FIG. 31.—THE DETECTION OF PREGNANCY IN THE COW BY RECTAL EXAMINATION.

up between the thumb
Does it feel like a
enlargement at one

ve and shape are assessed.
or is it elongated with en-
it contains a fully

developed corpus luteum. It may be possible to detect the protrusion of that structure from the surface of the ovary. If the animal is pregnant the embryo will occupy the cornu on that side. Or is the ovary

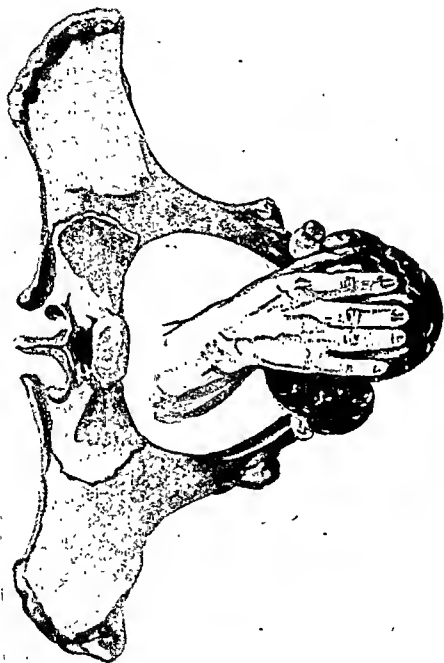


FIG. 34.—THE DETECTION OF PREGNANCY IN THE COW BY RECTAL EXAMINATION. Uterus gravid 90 days.

small and flattened from side to side? If the latter is the case, the animal is not pregnant on that side. If neither ovary is of a size sufficient to contain a fully developed corpus luteum, the animal is not

backwards. In this way a nodular object will be felt. Having located an ovary, an opportunity is awaited when the bowel is relaxed to pick it

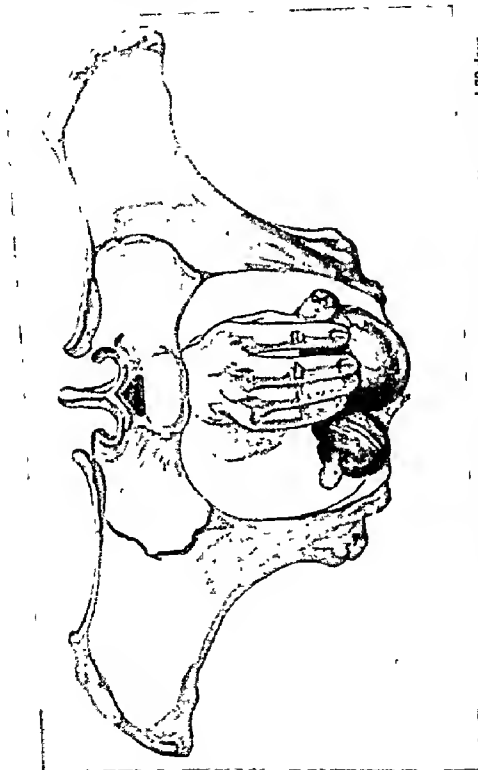


FIG. 13.—THE DETECTION OF PREGNANCY IN THE COW BY RECTAL EXAMINATION. Uterus gravid 70 days.

up between the thumb and fingers. Its size and shape are assessed. Does it feel like a plum or a large damson, or is it elongated with enlargement at one pole? If so, it is highly probable it contains a fully

developed corpus luteum. It may be possible to detect the protrusion of that structure from the surface of the ovary. If the animal is pregnant the embryo will occupy the cornu on that side. Or is the ovary

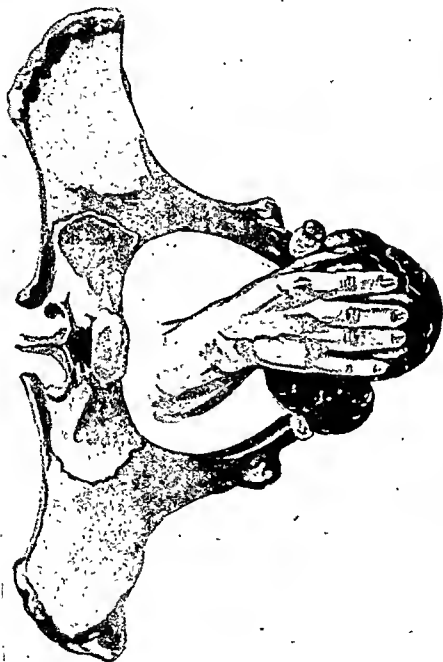


FIG. 34.—THE DETECTION OF PREGNANCY IN THE COW BY RECTAL EXAMINATION. Uterus gravid 90 days.

small and flattened from side to side? If the latter is the case, the animal is not pregnant on that side. If neither ovary is of a size sufficient to contain a fully developed corpus luteum, the animal is not

pregnant (other than to a mating of not more than 7 days previously). The case is one of:

- (a) Œstrus—turgidity of the uterus and copious vaginal mucus give additional evidence. It is probable also that a follicle will be detected.

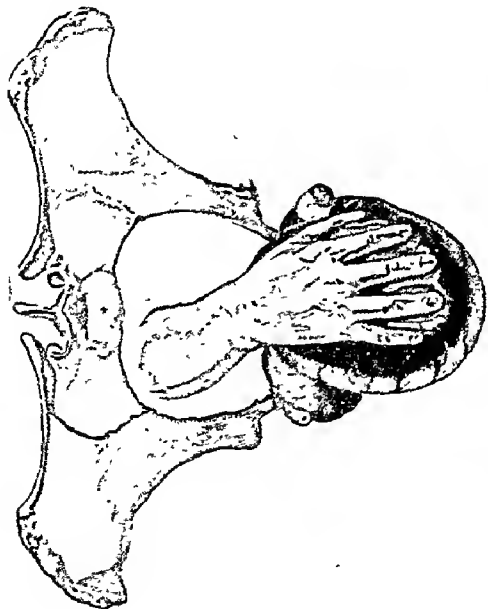


FIG. 35.—THE DETECTION OF PREGNANCY IN THE COW BY RECTAL EXAMINATION.
Uterus gravid 110 days.

(b) Metœstrus—from 2 to 6 days after œstrus.

(c) Anœstrus—the ovaries are functionless.

In exceptional cases a corpus luteum may be present in both ovaries; such an animal may be pregnant with twins—in which case a

fœtus will occupy each cornu; with a single fœtus only, or not pregnant. (For dimensions of the ovaries refer to Chapter 1.)

Sometimes, despite the ovaries being within reach, it is difficult to locate one or both. When, for instance, the pelvis is partly occupied by

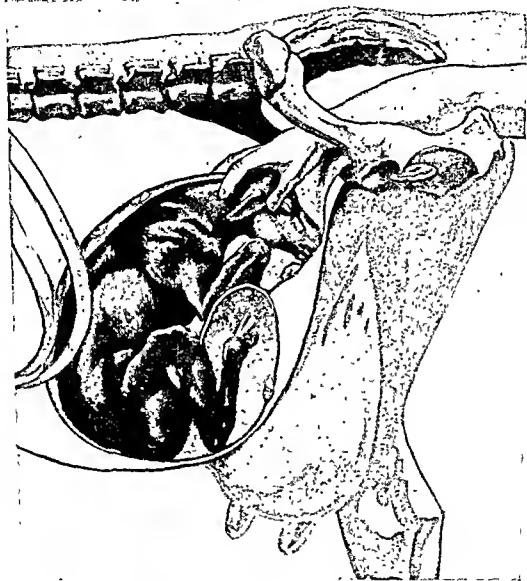


FIG. 36.—PREGNANCY APPROACHING TERM.

a distended urinary bladder, the uterus may become rotated on its long axis, with the result that one ovary is situated beneath it. Again, in animals difficult of examination for one or other of the reasons previously referred to, one may be unable satisfactorily to examine the ovaries.

Thus in the case of an animal which was mated up to a period of

3 months previous to examination one of the following conclusions will be made:

- (a) Not pregnant—either quiescent or in œstrus.
- (b) Possibly pregnant, but not long enough for a certain diagnosis to be made.
- (c) Pregnant, based on uterine distension or the detection of the membranes or embryo.
- (d) Unable to express an opinion, difficulties associated with the individual having prevented satisfactory examination.

In animals pregnant 3½ months or more, the uterus will lie in the abdomen beneath the pelvic brim. The arm is introduced beyond the elbow and, using the fingers flatwise, the region is searched by pressing downwards. (It has already been ascertained that the uterus is not in the pelvis and that the cervix lies on the pelvic brim. In young cows these facts in themselves are strong evidence of pregnancy.) Should the fœtus be situated high up, it is probable that it will be felt. In the early stages it will be rather like a piece of wood which tends to sink away when touched; later, the outline of the presented part can be recognized. In those cases in which the fœtus cannot be felt, an attempt will be made to pick up two or three cotyledons by gently squeezing the uterus 3–4 inches in front of the pelvic brim. Before withdrawing the hand, the middle uterine artery on the gravid side should be sought and the nature of the pulse in it assessed. From mid-pregnancy onwards it can generally be felt. It is laterally situated, a little in front of the shaft of the ilium.

Cases are sometimes met in which neither fœtus, cotyledons nor changes in the arteries can be detected. In these one is often prepared to diagnose pregnancy on what is essentially negative evidence, viz.:

- (a) The history of service 4 or more months previously and the absence of heat since.
- (b) The absence of a small uterus and ovaries in the pelvis or at the pelvic brim.
- (c) The presence of the cervix drawn tensely on the pelvic brim.

In the late stages of pregnancy, difficulty seldom arises even when the fœtus itself cannot be felt by rectal examination or by ballottement, for in addition to the negative evidence previously outlined, the detection of the hypertrophied arteries and of cotyledons is generally easy. In heifers the mammary glands also afford positive evidence by this time.

Differential Diagnosis

The condition most likely to be mistaken for pregnancy is pyometra. It occurs most often in herds affected by *Trichomonas fetus* infection. After infected service the uterus enlarges and the corpus luteum persists in a manner similar to that of pregnancy, in fact it is probable that pregnancy is the precursor of pyometra. At 90 days the uterine distension is very similar to that of pregnancy except that it often feels tenser than normal. Often in pyometra the cornua are distended to an equal degree, and this is useful supporting evidence, but it is not invariable and cases of pyometra are seen in which the distension of the horn on the same side as the persistent corpus luteum is much greater than that of the other, while in twin pregnancy the fetuses often occupy both cornua. It is improbable that one will make a positive diagnosis of pyometra on a single examination at about 90 days. If, however, the last service was 4 or 5 months before and the uterus is still the approximate size of a 90 days pregnancy and it has remained unchanged over a series of examinations and neither fetus nor cotyledons have been felt, it is strong evidence of pyometra. The greater the time elapsing since service, the greater will be one's certainty. In trichomonas cases diagnosis is confirmed by a periodic discharge of muco-flocculent material from the vulva, in which the parasites can be found. It should, however, be stressed that in pyometra the cervix is closed and there is no escape of pus from the vulva. On vaginal examination of such cases, it is noticed that the mucus occupying the cervix is slimy and moist and not sticky and tenacious as in pregnancy.

In some cases of *T. fetus* infection it is found that the uterus is enlarged (cornua of 7-11 cm.) and flaccid, and that manipulation of it provokes a profuse vulval discharge of muco-flocculent material. The fact that manipulation causes this discharge is evidence that the uterine enlargement is not that of pregnancy. Such animals frequently void similar material from the vulva when they are lying down.

Under the heading of differential diagnosis should also be considered the presence of a partially resorbed (mummified) fetus *in utero*. In the majority of such cases, foetal death occurs at between the 5th and 6th months of pregnancy, but the corpus luteum persists and the fetus is retained. There is a progressive resorption of the foetal membranes, fluids and soft tissues and the fetus becomes a dry, shrunken mummy about the size of a rabbit. Generally the veterinarian is not consulted until the time for parturition has arrived or passed, and the condition is

diagnosed by rectal palpation. The hard, irregular contour of the distorted mass can usually be detected. There is a complete absence of fluid and the uterus, which has contracted on the mass, is well within reach of the hand.

Vaginal Examination

Examination may be manual or visual. In the latter case an illuminated speculum is used. The condition of the vaginal mucous membrane does not afford definite clinical evidence of pregnancy, for the degree of "dryness" and blanching which occur during the diœstrous period are very similar to those of pregnancy. It is to the external os of the cervix that attention is directed. During pregnancy the secretion of the cervical glands becomes gelatinous and tough, forming a plug for sealing the canal. In many cases the seal covers or protrudes from the external os. It has developed by the 60th day.

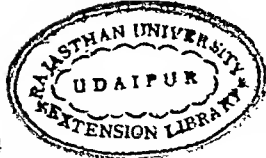
On manual examination the finger should be pressed into the os. The detection of an adhesive, tenacious secretion rather than a slimy, moist one is strong evidence of pregnancy. With a speculum the seal can sometimes be seen, light brown in colour, covering the os. In many cases, however, the seal occupies the canal only and cannot with certainty be detected.

The Mammary Glands

Mammary changes during pregnancy are best observed in primi-gravida. The teats of the pregnant heifer commence to enlarge about the 5th month and with a little experience it is an easy matter to distinguish them from those of the non-pregnant or early pregnant animal. From the 6th month the mammary glands become more firm to the touch and their enlargement can be seen. Hypertrophy is progressive and is particularly marked during the terminal month. As parturition approaches the glands become grossly enlarged and œdematous and the teats take on a waxy, tumefied appearance. The abdominal wall, particularly in the region of the umbilicus, may also become swollen by œdema. In the dry, milch cow, mammary enlargement occurs during the last 14 or so days of pregnancy.

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CHAPTER 4

PREGNANCY IN THE BITCH

ABSENCE of œstrus is no guide to pregnancy in the bitch, for in this species every œstrous period is followed by pseudo-pregnancy changes in the absence of pregnancy. It is generally accepted that the period of true œstrus ends more quickly once conception occurs. The deposition of abdominal and subcutaneous fat during pregnancy is often marked. It is a storing of fat for the subsequent lactation, for it is generally lost

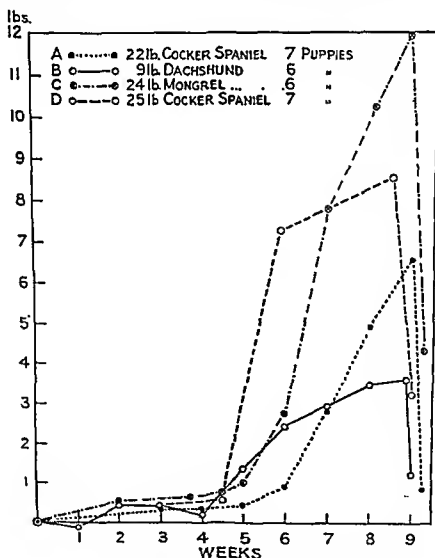


FIG. 37.—INCREASE IN BODYWEIGHT DURING PREGNANCY.

(Wright, 1934.)

again during the period of nursing. The gravid uterus and its contents cause no appreciable increase in bodyweight during the first 5 weeks. From this point it rapidly increases according to the number of fetuses. The increase will vary from 2½ lb. in a 10 lb. bitch, to 16 lb. or more in one of 60 lb., but by the time bodyweight has become a guide there are other very definite signs of pregnancy. In multiple pregnancy abdominal distension becomes progressive and obvious from the 5th week onwards, but in animals gravid with one or two fetuses only, and particularly when the bitch is large or very fat, distension may not be noticeable.

There are several causes of abdominal distension in the bitch which must be differentiated from pregnancy. The most important is pyometra, which occurs during the pseudo-pregnancy period; others are: ascites; peritonitis with effusion; splenic enlargement; neoplasia of the liver, abdominal lymphatic glands or uterus.

The Mammary Glands

Characteristic changes occur in the mammary glands. Unfortunately, similar, but less definite, changes may occur during pseudo-pregnancy. These changes are more easily recognized in primigravida. At about the 35th day in unpigmented skins, the teats become bright pink, enlarged and turgid—they stick out. This condition persists until about the 45th day, when the teats become larger still, but softer and tumefied. They may become pigmented. Appreciable hypertrophy of the glands commences at the 50th day. It progresses until at term the mammary glands comprise two parallel, enlarged and œdematous areas with a depression between them, extending from the pelvic brim to the anterior part of the chest. A watery secretion can generally be expressed from the teats 2–3 days before parturition. The onset of milk secretion coincides with parturition. In multigravida, mammary hypertrophy commences about 7 days before term and in some cases milk can be expressed from the teats several days before parturition.

Abdominal Palpation

This is the most certain method of diagnosis in the bitch. Facility or otherwise will depend on:

- (a) The size of the animal—the smaller the easier.
- (b) Its temperament—whether palpation is resisted.
- (c) The period in gestation at which examination is made.
- (d) The number of fetuses *in utero*.
- (e) Whether the bitch is of normal size or grossly fat.

18–21 *days*. At this stage the embryos represent a series of tense, oval distensions in the cornua, about $\frac{1}{2}$ inch long by $\frac{3}{8}$ inch broad. In small bitches which can readily be manipulated it may be possible to state approximately the number present. It is those situated in the posterior parts of the cornua which are most easily felt, and if one or two only, situated anteriorly, are present, they may be missed. In large or fat bitches it is improbable that embryos will be detected at this stage. Care must be taken not to confuse fæces in the colon with fœtuses.

24–30 *days*. This is the optimum period for the early diagnosis of pregnancy. By the 24th day these distensions have become spherical in outline, from $\frac{3}{4}$ –1 $\frac{1}{4}$ inches in diameter. They remain tense and are easily recognized. Sometimes there is variation in size, the posterior

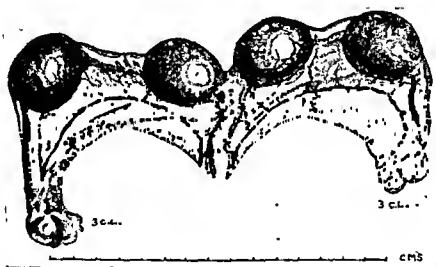


FIG. 38.—UTERUS OF BITCH.

Pregnancy of about 28 days. (Half natural size.)

ones being rather smaller than those in front. The embryonic units maintain this spherical form until about the 33rd day.

35–44 *days*. The constricted portions of the cornua between the embryonic units progressively dilate, the distensions become elongated, and much of their tenseness is lost. At this period the uterus comes into contact with the abdominal wall and in the animal pregnant with multiple fœtuses abdominal distension is commencing to be visible. Nevertheless palpation of the fœtuses themselves is not yet possible and as the uterus itself has lost much of its tension positive diagnosis may be difficult, particularly in those pregnant with one or two only.

45–55 *days*. During this stage increase in the size of the fœtuses is rapid. At the 45th day it may be possible to detect the posteriorly

situated ones between the fingers—in a 20 lb. bitch approximately $2\frac{1}{2}$ inches long and $\frac{1}{2}$ inch broad. It is during this stage that the disposition of the uterus in the abdominal cavity changes. In animals pregnant with multiple foetuses, each cornu represents an elongated cylinder, $1\frac{1}{2}$ –2 inches in diameter and 9–12 inches long. Posteriorly they extend into the uterine body, which has by this time become dilated. Each horn is in two segments—the posterior, which lies on the abdominal floor and passes forwards to the margins of the liver, and the anterior, which lies dorsal and lateral to it, with its long axis directed backwards towards the pelvis. In the last stages the uterus almost entirely fills the abdomen. (Figs. 204 and 205.)

55–63 days. During this period there should be no difficulty in diagnosing pregnancy provided the bitch allows manipulation of the abdomen. The size of the foetuses is such that they can readily be detected. High in the flank the one occupying the apex of the cornu will be felt, while the mid-line just in front of the pelvic brim is the one with its extremity in the uterine body. If manipulation is resisted, digital examination per rectum is helpful. The bitch's fore-parts should be raised and the uterus pressed backwards towards the pelvic inlet by pressure on the abdomen. The presented part of the posterior foetus will be detected beneath the finger. In big or fat bitches pregnant with one or two only, doubt may still exist, although by this time the mammary glands afford valuable confirmatory evidence.

Biological tests are not applicable in the bitch.

Radiography

Radiography may be of value as a diagnostic aid in the terminal stages. Results, however, are extremely variable and considerable technical experience may be necessary before foetuses can be demonstrated with certainty even at term. They are much more easily seen in small bitches than in large ones. In large and fat subjects a diaphragm or grid should always be used. Calcification of bone occurs chiefly during the last week of pregnancy and it is improbable, even in a small bitch, that the bony outline of the foetuses will be demonstrable earlier than the 58th day. As the writer sees the matter, the value of radiography in canine obstetrics lies in the demonstration at full term or after of a single foetus when palpation fails; and secondly the demonstration of presentation in obstructive dystocia.

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CHAPTER 5

PARTURITION

General

It is essential that the veterinarian shall be perfectly familiar with the normal course of parturition in the various species he is called upon to attend in order that he shall recognize at once when the process has ceased to be physiological and has become pathological. Not a little of his success as an obstetrician is dependent on the performance of the appropriate interference at the correct time, for it is important that he shall remember that it is his duty to conserve, if possible, the lives both of the mother and offspring.

The most certain indication of the approach of parturition is the onset of mammary activity. The glands which have been undergoing hypertrophy for a variable period during gestation, according to the species and type of animal concerned, commence to secrete milk.

During the terminal stages of pregnancy the vulval labiæ become swollen, prominent and resilient, and there is a mucoid vulval discharge. These are well seen in the cow, ewe, sow and bitch, although in the mare tumefaction of the labiæ is not marked and the vaginal mucosa remains "gummy" up to the time of foaling.

Prior to parturition the pelvic canal undergoes changes: the sacro-sciatic ligaments soften and the apex of the sacrum tends to be displaced upwards due to relaxation of the sacro-iliac ligaments. These changes are best observed in the bovine; the hindquarters have a sunken appearance and the tail-base is carried high. The posterior borders of the sacro-sciatic ligaments, extending from the base of the tail to the ischial tuberosities, cease to be tense and cord-like and become soft and resilient. Such changes are evidence that the onset of parturition is a matter of a few hours only.

In the bitch and cat and to a lesser extent in the sow, certain psychological changes indicate the nearness of labour. The animal seeks a place for her confinement—often a most inconvenient one—and prepares her bed. When housed, she may tear up furnishings or scrape paper from walls in the process.

The onset of parturition is due to complex hormone influences arising in the pituitary gland, the ovaries, the suprarenals, the placenta and possibly the foetus and uterus also. The uterine musculature, which has been in a state of tonic contraction throughout pregnancy, becomes sensitized to the whipping action of the oxytocic factor of the posterior pituitary hormone. The uterine cervix, influenced by an anterior pituitary hormone, relaxes and the tenacious mucus which has occupied it during pregnancy liquefies. Changes are occurring in the placenta; union is becoming less intimate and the superficial cells are undergoing fatty degeneration. In those species with a deciduate placenta, separation of the margins, with hæmorrhage, is commencing. Much of the maternal blood which has been traversing the placenta is being diverted to the active mammary glands.

In the early stages of labour the expulsive forces are entirely involuntary and are confined to the uterus. Later, consequent on distension of the anterior vagina by the foetal membranes and the pressure of the foetus at the pelvic brim, forceful reflex and voluntary contractions of the abdominal muscles and diaphragm occur.

Stages of Labour

First Stage: Dilatation of the cervix.

The onset of uterine contractions forces the foetal membranes with their contained fluid against the relaxed cervix, causing it to dilate. In the bovine, cervical relaxation commences at the uterine end and during the first stage of labour the cervix comprises a short, frill-like stricture about 1 inch thick, occupied by the remains of the mucus seal and into which several fingers can be inserted. At the commencement of the stage contractions occur every fifteen minutes or so and persist for 15-30 seconds; but as it advances they gradually increase in frequency, strength and duration until towards its end they recur every few minutes. Contractions comprise both peristalsis and segmentation, and they are essentially intermittent, for were they to become continuous, circulatory stasis in the placenta would jeopardize the life of the foetus. Contractions do not involve the uterus evenly throughout. In the uniparous species they commence at the apex of the cornu; the posterior part remains passive and dilates as the result of hydraulic pressure from in front.

During this period the foetus is changing its position—it is undergoing deformation. In the case of the foal and puppy there is a progressive rotation from the ventral to the dorsal position and the fore-limbs, head and neck are being extended. In the case of the calf and lamb,

extension only is necessary to change the foetus from its gestational posture to that of presentation.

By the time the stage is completed, the cervix is obliterated and the uterus and vagina have become a continuous canal.

In the multiparous species the mechanism of uterine contraction is most complex, for the process just described only applies to the foetus whose membranes are adjacent to the cervix. The remainder of the uterus remains passive. Once a segment has emptied itself, the one immediately anterior to it, or the posterior segment of the opposite cornu, is set in motion. Those parts of the cornu already emptied remain shortened by the continuous contraction of their longitudinal fibres, but serve for the passage of subsequent foetuses by relaxation of the circular ones. Thus throughout parturition the cornua become progressively shortened and as one foetus is born the membranes of another become adjacent to the pelvic brim.

The duration of this stage is generally from 3 to 6 hours, but the absence of subjective evidence makes exact determination impossible. It is characterized by abdominal discomfort, which at first is intermittent but later becomes almost continuous. Pulse rate and respirations are generally accelerated and body-temperature remains normal or becomes slightly subnormal.

Second Stage: Expulsion of the foetus.

During the previous stage, the foetus with its membranes has been forced backwards to the pelvic inlet. The allantois-chorion, consequent on its backward movement being restricted by the placenta, ruptures and a gush of fluid escapes from the vulva. The distended amnion, its relations being much less confined, and with it parts of the foetus, are forced into the pelvic inlet. This provokes powerful reflex and voluntary contractions of the abdominal muscles and diaphragm, and "straining" commences. The amniotic sac traverses the vagina and appears at the vulva to form the "water bag." Intermittent straining continues and the extremities of the foetal limbs appear in the water bag. In the case of the large uniparous species one slightly precedes the other. By this time the amniotic sac is usually hanging beneath the vulva. The amnion has about reached the limits of its movement and it is ruptured by the pressure of the foetal limbs. Amniotic fluid escapes. The foetal head now occupies the vulval labiae and a considerable effort with marked stretching of the lips is generally required before the occiput passes through. At this point the animal may have a rest, but soon straining will

recommence and after a further series of forceful expulsive efforts the foetal thorax passes through the vulva. As a rule birth of the chest is quickly followed by that of the hips. The hind limbs may also be expelled at the same time, although in many cases no further effort occurs after the birth of the hips and the hind limbs remain in the vagina until they are freed either by movement of the young one or by the mother rising from the ground.

As has previously been pointed out, the amniotic sac is generally ruptured by the foetal limbs, but the membrane generally covers the face until the young one is born. Foetal movement, however, quickly causes it to be drawn away, and respirations, often accompanied by a cry, commence. Occasionally the foetus is born without rupture of the amnion and there is a risk, if aid is not quickly forthcoming, that the young one will die. It would appear that the stimulus to breathing is in part the presence of air at the nostrils, for it has been observed both in the foal and calf that when the foetal face has become uncovered during the course of birth that respirations have commenced despite the fact that some time may elapse before delivery is complete.

It will be noticed that at no time during its birth has the foetus come into direct contact with the walls of the genital tract. The amniotic membrane has served as a glistening and well-lubricated sheath through which it has passed. The duration of this stage and the degree of effort required for its completion is generally greater in primigravida than in multigravida.

In both mare and cow, the foetus is normally delivered in anterior presentation, dorsal position and extended posture, and in the former species the great majority of young are so expelled. In the cow, however, an appreciable number are delivered in posterior, dorsal, extended presentation without assistance or the foetus suffering from harm therefrom. In the multiparous species, the proportion of foetuses delivered posteriorly is so high (probably up to 30 per cent.) that the presentation must be regarded as a normal one. In the multiparous species, also, it is necessary for this stage to be repeated for each foetus.

Third Stage: Expulsion of the foetal membranes.

With the birth of the foetus, visible straining largely ceases, but the uterus continues to contract, for its work is not yet complete—the foetal membranes must be expelled.

Detachment of the placenta is an active process associated with uterine contraction. It has already been proceeding during the second

stage and it is completed in the third. Peristaltic waves, originating at the apex of the cornu cause the allanto-chorion to become inverted and this inversion goes on to completion until the membranes are expelled from the vulva with the allantoic surface outermost. A variable degree of straining occurs during this stage. In the multiparous species the process is complex, for it must be repeated for each set of membranes. The subject, however, will be discussed in greater detail when considering the species individually.

THE MARE

The imminence of labour can be recognized by the degree of mammary hypertrophy, waxing of the teats and possibly the escape of milk from the glands.



FIG. 39.—THE MAMMARY GLANDS OF A SUFFOLK MARE 8 HOURS BEFORE PARTURITION.
Beads of wax are present on the teats.

The best indication that the first stage has commenced is the onset of patchy sweating behind the elbows and about the flanks. Although it occurs in the majority of mares, it is by no means invariable. It commences about 4 hours before the birth of the foal and increases as the stage progresses.

At the commencement there are no obvious indications of pain, and food is generally taken readily. Respirations are normal and the pulse rate about 60. (This increase in pulse rate is not significant of the onset of labour, for it develops during the terminal stages of pregnancy.) There is evidence that body temperature may become slightly subnormal during the first stage (98–99° F.)

As the stage advances the mare becomes restless and tends to wander aimlessly around the loose-box. The tail is frequently raised or held to

one side. There may be swishing of the tail or slapping of it against the anus. As the end of the stage approaches the mare becomes very restless. This is indicated by crouching, straddling of the hind limbs, going down on the knees or breast and rising again, glancing at the flank. The stage terminates with rupture of the allanto-chorionic membrane and the escape of urine-like, allantoic fluid from the vulva. Its quantity is not copious. It will be noticed that there is no reference to visible straining during this period in the mare.

The onset of the second stage occurs abruptly. It is characterized by the appearance of the water bag or the commencement of forcible straining. There is never much delay between them and they often coincide. Very soon after straining commences, the mare goes down. She passes on to her side with limbs extended and generally remains in this position until the foal is born. The presence of the water bag at the vulva is quickly followed by the appearance in it of a digit. Straining efforts recur at fairly regular intervals; each bout comprises three or four powerful expulsive efforts followed by a period of rest, generally of about three minutes. One fore-limb precedes the other by a distance of about 6 inches and this position is maintained until the head is born. The point is a significant one, for it indicates that one elbow passes through the bony pelvic inlet before the other, and in this way nature has provided that the foal shall present the minimum obstruction at the pelvic inlet. During its delivery, the head is generally in the oblique position, it may even be transverse—the cheek lying on the limbs—but this is probably due to rotation of the cervical joints within the pelvis and should not be taken as evidence that the presentation was oblique.

The greatest effort is generally associated with birth of the head; the chest presents less difficulty, and following this the hips slip out easily. Although delivery in the mare is comparatively rapid it constitutes a tremendous effort, and after expulsion of the foal she may remain lying on her side exhausted for anything up to 30 minutes.

The umbilical cord is intact when the foal is born. It subsequently ruptures, 2-3 inches beneath the belly, as the result of movement either by the mare or foal.

The duration of the second stage in the mare is generally less than 30 minutes, it may be as short as 10. The longest the writer has observed within normality was 70 minutes, and in this case it was seen that the greater part of the placenta came away with the foetus. It is probable that this is near the limit of the time available if parturition is to remain normal, for in the mare separation of the placenta tends to proceed

rapidly once the second stage commences and if delivery occupies too long a time it is likely the foetus will succumb from this cause.

In the majority of mares the membranes are expelled quickly after the birth of the foal, generally within 3 hours; in fact they may fall away in half an hour or so. Occasionally, however, cases are met in which periods up to 24 hours elapse before the membranes fall away, yet the animal suffers no ill-effect therefrom. The recognition of the exact time at which a case becomes pathological and interference is necessary is a difficult problem. As has already been pointed out, the membranes are expelled with the allantoic surface of the allantois-chorion outermost. This statement holds for those cases in which expulsion occurs early after parturition, but it has been noticed that in those in which there is delay, the placental surface is outermost, indicating that separation was complete before expulsion commenced.

THE COW

The immediate approach of labour has been recognized by slackening of the pelvic ligaments and the change of the mammary secretion from a relatively transparent, honey-like secretion to an opaque cellular secretion—colostrum.

There is great variation in the intensity of the symptoms of the first stage, in fact, many subjects, particularly multigravida, show none. Others, usually heifers, may show signs of abdominal pain for periods up to 24 hours before the cervix is completely dilated. Another feature of the cow is that occasional straining may occur during the first stage. Food is only "picked"; rumination is irregular; there may be "lowing" or kicking at the belly. The animal is obviously restless; she may stand with her back arched and tail raised; she may go down and rise again frequently. The line of demarcation between the first and second stages is not clear-cut, as in the mare. Body temperature is generally normal, but the pulse rate is often increased to between 80 and 90.

The second stage is less intense but of longer duration than in the mare. Straining is less frequent and the animal often remains standing at first. During the passage of the head through the vulva, however, the cow generally goes down and remains recumbent until the calf is born. She may lie on her side, but more often adopts breast recumbency. Taking the appearance of the water bag as the time of its onset, the second stage may occupy from $\frac{1}{2}$ to 4 hours. Beyond this time it is probable that labour is abnormal. During the second stage, temperature may rise to 103 or 104° F., but this is by no means constant and is

probably dependent on the degree of effort required. The pulse rate may increase to 100 or more.

Placental separation occurs more slowly in the cow than in the mare, and thus the stage of expulsion may occupy considerably longer without jeopardizing the life of the young one. The process of expulsion is similar to that described for the mare. The umbilical cord is shorter in the calf than in the foal and its rupture generally occurs as the young one falls from the vulva.

Expulsion of the foetal membranes usually takes place from 2-8 hours later; occasionally it may be delayed to 12 hours, but when 24 hours elapses and the membranes are still in the uterus it is probable the case is one of pathological retention. Unless prevented from doing so, it is customary for the cow to eat the foetal membranes. It will also be noticed during the first and second stages that there is a tendency to lick up vulval discharges.

THE BITCH

The imminence of parturition has been indicated by the animal preparing her bed. In primigravida the onset of lactation coincides with parturition, but in multigravida milk may be expressed from the teats for several days prior to its onset.

There is nothing characteristic about the first stage, but it is generally noticed that the bitch is restless, indifferent to food and inclined to pant. It is most obvious in primigravida and occupies about 12 hours.

The onset of the second stage is indicated by straining. In the majority of cases the animal remains in her bed in breast recumbency, although sometimes she may stand and move about during straining efforts. The water bag of the first foetus appears at the vulva and following a series of efforts attains the size of a golf-ball. It is generally ruptured by the bitch, who licks vigorously at her vulva. As with other species, delivery of the head requires the greatest effort, and in the majority of instances once this is born the remainder of the foetus follows easily. Expulsion of the first foetus may occupy up to an hour, but seldom longer if the process is normal. It is often quicker; a matter of a quarter of an hour or so.

The umbilical cord is intact at the birth of the puppy, but it is quickly torn by the mother, who bites it away.

As a rule the bitch rests for a time after the birth of her first puppy. She lies licking her young one, which soon commences to suckle. She pays frequent attention to her vulva, and licks up any discharges. The

fœtal membranes are generally voided in 10–15 minutes and are promptly eaten by the bitch.

Straining recommences after a variable delay. This delay may be half an hour only; it may comprise 1–2 hours. (The writer has seen it occupy 7 hours in a bitch pregnant with two fœtuses only.) The effort required and the time occupied for the delivery of the second fœtus is usually less than for the first. This may be followed by a further period of rest, but quite frequently a third puppy quickly follows the second.

The stage of expulsion of the fœtuses is most irregular; one bitch may have her first puppy and then rest for several hours, then deliver two or three more in quick succession, and then rest again before expelling several more; while another may expel them at fairly regular intervals throughout the period. There is no rule. In an exceptional case a bitch may deliver the whole of her litter in an hour or so.

Expulsion of the fœtal membranes is also irregular. They may come individually. In other instances a puppy may be born with the membranes of its predecessor around its neck while its own come away with it, dragged by the cord.

The total time occupied by the second stage will depend chiefly on the number of fœtuses, but as a general rule when the litter is within the usual limits (4–8), it occupies about 6 hours. The question arises—what is the maximum time it may occupy, especially when the number of fœtuses is very high (10–14)? The writer would put it at 12 hours at the outside. It is very improbable that puppies born after this time, even without assistance, will be alive.

The fœtal membranes of the last fœtus are generally expelled with it or shortly afterwards. Exceptionally, however, there is a delay up to 24 hours before parturition is finally completed.

A feature of parturition in the bitch is that much of the uterine discharge is dark green in colour. This is due to the fact that decidual separation has been going on for several days before parturition commences and blood which has escaped has undergone bile-like changes.

OTHER ANIMALS

In the ewe the course of parturition is very similar to that described for the cow, except that the incidence of twinning and even triplets is high in those ewes which have “been done well” previous to mating time.

In the sow the course is similar to the bitch. The animal lies flat on her side and the fœtuses are expelled fairly regularly. Even when the

litter is large (12-14), it is probable that the second stage will be completed within a period of 4 hours. Expulsion of the membranes differs from the process in the bitch, for in the sow a number of allanto-chorionic sacs often become fused together with the result that the membranes are expelled as two or three masses during the course of labour.

In the cat the process is similar to the bitch. The number of foetuses is more regular (3-5) and the normal stage of expulsion occupies about 6 hours.

CHAPTER 6

MATERNAL DYSTOCIA

DYSTOCIA implies some obstacle to parturition whereby the young cannot be delivered by maternal effort alone. Of the domestic species, the dairy bovine is the one most often involved, but the incidence is high also in the ewe, especially with twinning. In the mare and sow it is much less common. In the bitch the frequency of the condition varies with the different breeds: it is comparatively common in the Scottish terrier, Pekingese, Bulldog and Sealyham, but is less common in the more natural breeds of dog and in mongrels. In the cat the incidence is higher than in the normal breeds of dog, but lower than in the special breeds mentioned.

Difficult birth is more common in primigravida than in multigravida. It is classified as maternal when the essential cause lies in the mother and foetal when the young one is primarily responsible. While it is appropriate to deal with the former type first, it must be understood that the latter is the more common.

Pelvic Abnormalities

Speaking generally, developmental abnormalities of the pelvis are rare in animals and such conditions as the rachitic pelvis are of little consequence. In the achondroplastic types of dog, however, the pelvic inlet is flattened in the sacro-pubic dimension and this, together with the large head of the foetus in these types, is a cause of dystocia. A not uncommon cause in the bitch and sow is reduction in the ischial dimension due to previous fracture of the pelvic wall with displacement.

The Uterine Cervix, Vagina and Vulva

Failure of the Cervix to Dilate

Failure of the cervix completely to dilate is a relatively common cause of dystocia in the dairy bovine. It may occur both in the heifer and the multiparous cow. In the latter, the condition has generally been ascribed to fibrosis of the cervix resulting from injury at previous parturitions. But the author is doubtful if this explanation is correct. He thinks it

more likely to be the outcome of hormonal dysfunction, for generally the course of labour in such cases is atypical. Pains are weak and transient only. Often it is difficult to ascertain accurately how long labour has been existent, for other than discomfort, little may have been noticed. On examination the cervix is found to comprise a frill about 2 inches broad, separating the vagina from the uterus and it is clear that delivery by forced traction must inevitably cause severe tearing. Often the amniotic sac has passed through the cervix and may be present at the vulva; it may have ruptured with escape of amniotic fluid. Sometimes foetal limbs have passed into the anterior vagina.

In order not to be precipitate in his actions, the obstetrician may decide to wait several hours before interfering in the hope that the case is simply one of delay and that normal dilatation will later occur. (He is aware of the relative frequency with which discomfort, particularly in heifers, is a feature of the first stage of labour during which the cervix is dilating normally.) In the condition under review, however, there will be no further dilatation. The author has on occasion waited for a further 12 hours, by which time the calf has died, without any change in the cervix.

In some cases of abortion also the cervix fails properly to dilate and the foetus is retained, subsequently to undergo putrefactive maceration in the uterus. Incomplete dilatation of the cervix is sometimes an accompaniment of uterine torsion.

Vaginal Cystocele

This is the name given to a condition occasionally encountered in the parturient mare and cow in which the urinary bladder lies in the vagina or vulva. It is of two types: (a) eversion of the bladder through the urethra—this is more likely to occur in the mare consequent on the great dilatability of the urethra and the force of straining efforts in this species: the everted organ will occupy the vulva and will be visible between the labia; (b) prolapse of the bladder through a rupture of the vaginal floor: in this condition the bladder will lie in the vagina and it will further differ from the previous one in that the serous coat of the organ will be outermost.

In both conditions the first aim of treatment is to overcome straining, and this is best effected by the induction of epidural anaesthesia with or without narcosis. This must be followed by retropulsion of those parts of the foetus which already occupy the vagina. In the case of the first it is then necessary to invert the organ again by manipulation, and in the

second, to replace it in the pelvis and close the vaginal rupture by suture. The foetus should be delivered by traction after the correction of any postural abnormality.

Neoplasms

Neoplasms of the vulva and vagina may occur in all species and thus serve as potential causes of dystocia, although in fact it is seldom that they do so. In the cow, the writer has encountered papillomata, sarcomata and submucous fibromata of the vulva, while in the bitch the vaginal submucous myxo-fibroma is common. Neoplasms of the cervix are so rare in animals as to be of no consequence in a consideration of the causes of dystocia.

Other Abnormalities

Remnants of the Mullerian ducts often persist in the anterior vagina of the bovine. They generally have the form of one or more "strings" passing from the roof to the floor just behind the cervix and are usually broken during parturition. Sometimes they are laterally situated and the foetus passes to one side of them. Occasionally, however, such a remnant is of such size and strength that it forms an effective barrier to the birth of the young one. The fore limbs may pass on either side of it. It is important that the obstetrician shall recognize what he is dealing with and not confuse the condition with a partially dilated cervix. Satisfactorily to examine the vagina, it is often an advantage to induce posterior epidural anaesthesia and repel the foetus into the uterus. The obstruction can be cut without risk, using a hook knife or a guarded embryotomy knife of the Colin's or Roberts' type. Cases of bifid and double cervix are occasionally seen on random post-mortem examination of bovine genitalia and there is generally plentiful evidence that the animal involved has had one or more calves. The condition is unlikely to be a cause of dystocia.

The Uterus

Two uterine abnormalities are frequent causes of dystocia: torsion of the organ and inertia of its musculature.

Torsion of the Uterus

Twist of the uterus on its long axis. The condition is most common in the cow and is occasionally met in the ewe and goat. In these species the twist occurs immediately anterior to the pelvic brim. It also occurs

in the bitch and sow but in these one cornu is as a rule involved. In the ruminants it is thought that the anatomical arrangement of the uterus—the dorsal situation of the greater curvature and the ventral attachment of the broad ligaments—favour the occurrence of twist which is explained simply as a gravitational accident. In the sow and bitch cornual torsion is usually complete and tense and it is probable that irregular uterine contraction is the cause.

THE COW

In the great majority of cases the twist is a partial one, the uterus having rotated through an arc up to 180 deg. Its direction may be towards the right or left. (Cases have been described in which the uterus has made several complete twists, but this cannot apply to the comparatively simple condition so well recognized in bovine obstetrics. Complete twist would probably result in death and resorption of the fœtus and possibly rupture of the uterus. It is possible that those cases described as abdominal extra-uterine pregnancy in which a mummified fœtus has been found in the abdominal cavity were due to complete torsion with subsequent rupture of and expulsion of the fœtus.)

The condition is met in primigravida and multigravida. It has been ascribed to mechanical causes such as slipping, falling or struggling while cast, and also to energetic movement on the part of the fœtus. The last would seem to be the more rational explanation. It is probable that in the majority of cases the accident occurs early in the second stage of labour for it is a striking fact that in a typical case the cervix is found to be completely dilated once the abnormality is corrected. At the same time the writer has encountered cases in which the cervix was only partially dilated and in these he believes the abnormality occurred during the first stage.

Symptoms. Up to the onset of parturition the animal has been normal. Forceful, second stage labour has generally been in progress for several hours before advice is sought. As a rule there has been no sign of a water bag and it may be noticed that the vulva appears to be drawn into the pelvis. Vaginal examination serves to establish a diagnosis. In most cases the organ appears to end abruptly at the pelvic brim although in exceptional ones it may be found that one or two foetal limbs have already entered the vagina. The mucous membrane is drawn into spiral folds which become more and more tense towards the cervix. It may be possible to detect the direction of these folds. The course of the vaginal arteries may indicate the direction of the twist. Normally they can be

felt just below the midline on each side running forwards in a tortuous manner. In torsion they become tensed and their direction spiralled.

Treatment. If unrelieved it is highly probable the condition will prove fatal—fœtal death, putrefaction, toxæmia. There is a possibility provided the uterus does not sustain injury during ineffective attempts at correction that the fœtus will undergo putrefactive maceration *in utero* and the cow survive.

Rotation of the cow's body. This is the treatment most often adopted in this country. The object is to roll the cow's body so that, the uterus tending to remain stationary, the twist becomes corrected. While the mechanics of the operation may be questioned it is an undoubted fact that in many cases the abnormality is found to be corrected after the procedure. Theoretically the cow should be rolled in the same direction as the twist. Often, however, this cannot be ascertained and the animal is rolled in one direction and if this is unsuccessful, in the opposite.

Right torsion: Cast the animal by Reuff's method on to its right side and hobble all four feet together. Suddenly pull her on to her back and allow her to fall on to her left side. During the manœuvre the obstetrician has his hand in the vagina. If the twist is being reduced, the constricted neck will be felt to open and the fœtal membranes and possibly parts of the fœtus will quickly pass into the dilated canal. If this fails, rolling should be repeated several times in the same and then in the opposite direction.

In a recent case it is probable that parturition will proceed unaided after correction. If, however, inertia has supervened or palpation reveals some postural abnormality, manipulative delivery should be proceeded with.

Suspension of the cow's body. This method has been recorded in America. It also is based on the mechanical theory of reduction. If the cow's hind parts are raised with her ventral abdominal wall uppermost, gravity will cause the uterus to fall back into its normal position.

After appropriate padding, a chain or rope is tied firmly around each hind leg above the hock. (If she is not already recumbent, the cow is cast.) Into each of these the hook of a swingle-tree is inserted. The latter serves to spread the limbs and also to take the hook of the block and tackle which is used to raise the animal. The block is fixed to a rafter. The cow is raised until its back forms an angle of at least 45 deg. with the floor. The shoulders remain on the ground while the head is restrained. During elevation a hand is kept in the vagina to ascertain when correction has taken place.

Rotation of the fetus. For this purpose a torsion fork (Cämmerer's) with canvas cuffs is employed. It is only applicable in those cases of partial twist in which either the fore or hind limbs can be drawn into the vagina. The cuffs are placed as high up the limbs as possible and into each is inserted a prong of the fork. Extension of the limbs is maintained by digital snares attached to the wooden bar which is used to rotate the fetus and with it the uterus.

The stimulation of vigorous fetal movement. It has already been suggested that vigorous fetal movement during the early stages of labour is a likely cause of the condition. Equally, similar movement may correct it.

In those cases of partial twist in which it is possible to pass the hand into the uterus, firm pressure on the fetal eyes (with the lids to protect them) may cause vigorous reflex movement and correction of the torsion.

Abdominal ballottement. Auld (1947) recommends abdominal ballottement. The manipulation is performed with the animal standing. Two assistants are required; one on the right side with clenched fists pushes downwards and inwards, and the other on the left pushes upwards and inwards low down on the flank. They push alternately, each at a rate of about one per second. The object is to cause the uterus to swing. If the cervix will admit the passage of the hand, the operator is able to assist the correction, otherwise he may assist by rectal manipulation of the fetus. Auld states that with the uterus swinging slightly, very little pressure from the operator will cause the fetus to wriggle into the normal position and take the uterus with it. He also states that in all his cases, more than a hundred, the torsion was anti-clockwise.

Intra-abdominal manipulation. Both Welsh (1944) and Gendreau (1944) recommend manipulative correction of the position of the uterus after laparotomy in the right paralumbar fossa in those cases in which simple methods fail. Operation is performed in the standing position under local infiltration anaesthesia (posterior epidural anaesthesia may be employed in addition to overcome straining). (In Great Britain the Animals (Anaesthetics) Act, 1919, provides that the operation of laparotomy in the bovine shall only be performed under general anaesthesia.) A 6- to 8-inch incision is employed. The hand is introduced into the abdomen and omentum, which covers the uterus at this point, drawn forwards. The uterus is readily recognized by its contained fetus. If the twist is to the left, that is, towards the rumen, the hand is passed over its dorsal aspect and then downwards. Search is

made for some part of the foetus which may be used as a pressure point in the subsequent rotation. In right-sided twist, the hand is introduced downwards between the uterus and the abdominal wall. If no foetal "band hold" is found the uterine wall itself may be used for rotation pressure. Directional diagnosis is sometimes difficult and thus if difficulty is experienced in correcting the torsion in one direction, the opposite should be tried. Closure of the abdominal wound is as described for caesarian section. Following correction, normal delivery may be allowed to proceed or, in the case of delay, assistance given. Welsh is of the opinion that the chief cause of failure of simple methods to correct the torsion, is the size and consistency of the rumen. If the rumen is distended and of firm consistency simple methods will probably fail.

Cornual Torsion in the Bitch

This is a rare abnormality which has been observed on post-mortem examination of fatal dystocia cases. Other cases are on record in which encapsulated foetal bones have been found in the abdominal cavity and the probability is that these were originally cases of cornual torsion with rupture, expulsion of the foetus into the abdomen and subsequent resorption of the soft tissues. In this species also it is probable that the accident occurs during labour and is the outcome of irregular uterine contractions.

In the bitch, caesarian section can be approached with confidence provided it is performed early while the uterine contents are still healthy. It is improbable that the condition under review will be positively diagnosed during the course of labour but failure to deliver after a vigorous effort of 6 hours or so from any cause is an indication for the operation.

Hernia of the Gravid Uterus

THE MARE AND COW

Occasionally in these subjects hernia of the gravid uterus occurs through a rupture of the abdominal floor. The accident is one of advanced pregnancy, occurring at the 9th month or later in the mare, and from the 7th month onwards in the cow. It is probable that in the majority of cases a severe blow on the abdominal wall is the exciting cause although many observers have stated that it may occur without traumatic influence; the abdominal musculature becoming in some way so weakened that it is unable to support the gravid uterus. The site of the original rupture is the ventral aspect of the abdomen, a little to one

side of the midline (left in the case of the mare and right in the cow) behind the umbilicus. It generally commences as a local swelling about the size of a football but rapidly enlarges until it forms an enormous ventral swelling extending from the pelvic brim to the xiphisternum. It is most prominent posteriorly where it may sink to the level of the hocks. By this time practically the whole of the uterus and its contents have passed out of the abdomen to occupy a subcutaneous focus. In cattle the bulk of the swelling is often situated between the hind legs, the udder being deflected to one side. Generally, the condition is complicated by gross œdema of the abdominal wall due to pressure on the veins; in fact this œdema may be so great that it is impossible to palpate either the edges of the rupture or the fœtus.

As a rule gestation is uninterrupted but the condition becomes grave both for the mother and fœtus when parturition commences, particularly in the case of the mare, although there are records of affected cows calving normally. In the mare, if the foal is to be saved, it is essential that aid shall be forthcoming the moment the expulsive forces of labour commence. The writer has encountered a case in which delivery of the foal by traction presented no difficulty despite the downwards deviation of the uterus, but he visualizes cases in which displacement of the uterus places the fœtus beyond reach. In these it is advised that the mare be cast and narcotized, turned on to her back and the hernia reduced by pressure. Attempts at delivery should be made with the animal in this position. After parturition and involution of the uterus, the hernia will become occupied by intestine. It is improbable, however, that strangulation will occur and the mare may be able to suckle the foal. At the end of this period she should be destroyed.

In view of the uncertainty of the preceding procedure it may be decided to perform cæsarian section as full term approaches and to destroy the mother as soon as the uterus has been evacuated.

THE BITCH

Acquired inguinal hernia is common in the bitch and not infrequently the incarcerated uterus becomes the focus of pregnancy. (The writer has also seen the condition in the cat, but it is rare in this species.) The hernia is generally unilateral and it may contain one or both uterine cornua.

Often the history is that an inguinal swelling the size of an egg has been recognized for months, but that during the last few weeks it has rapidly become larger. In other cases, the recent development of a pro-

gressive swelling is the story. There may or may not be a history of recent œstrus and mating.

The lesion is obvious; it is unlikely that it will be confused with a

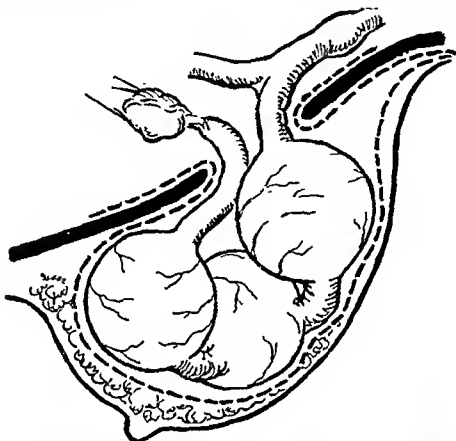


FIG. 40.—SCHEME OF INGUINAL HYSTEROCELE IN THE BITCH GRAVID WITH THREE EMBRYOS OF ABOUT 30 DAYS.



FIG. 41.—INGUINAL HYSTEROCELE IN THE BITCH.

Both cornua occupy a right-sided hernial sac. They contain partially resorbed, full-term, fetuses.

side of the midline (left in the case of the mare and right in the cow) behind the umbilicus. It generally commences as a local swelling about the size of a football but rapidly enlarges until it forms an enormous ventral swelling extending from the pelvic brim to the xiphisternum. It is most prominent posteriorly where it may sink to the level of the hocks. By this time practically the whole of the uterus and its contents have passed out of the abdomen to occupy a subcutaneous focus. In cattle the bulk of the swelling is often situated between the hind legs, the udder being deflected to one side. Generally, the condition is complicated by gross œdema of the abdominal wall due to pressure on the veins; in fact this œdema may be so great that it is impossible to palpate either the edges of the rupture or the fœtus.

As a rule gestation is uninterrupted but the condition becomes grave both for the mother and fœtus when parturition commences, particularly in the case of the mare, although there are records of affected cows calving normally. In the mare, if the foal is to be saved, it is essential that aid shall be forthcoming the moment the expulsive forces of labour commence. The writer has encountered a case in which delivery of the foal by traction presented no difficulty despite the downwards deviation of the uterus, but he visualizes cases in which displacement of the uterus places the fœtus beyond reach. In these it is advised that the mare be cast and narcotized, turned on to her back and the hernia reduced by pressure. Attempts at delivery should be made with the animal in this position. After parturition and involution of the uterus, the hernia will become occupied by intestine. It is improbable, however, that strangulation will occur and the mare may be able to suckle the foal. At the end of this period she should be destroyed.

In view of the uncertainty of the preceding procedure it may be decided to perform cæsarian section as full term approaches and to destroy the mother as soon as the uterus has been evacuated.

THE BITCH

Acquired inguinal hernia is common in the bitch and not infrequently the incarcerated uterus becomes the focus of pregnancy. (The writer has also seen the condition in the cat, but it is rare in this species.) The hernia is generally unilateral and it may contain one or both uterine cornua.

Often the history is that an inguinal swelling the size of an egg has been recognized for months, but that during the last few weeks it has rapidly become larger. In other cases, the recent development of a pro-

gressive swelling is the story. There may or may not be a history of recent œstrus and mating.

The lesion is obvious; it is unlikely that it will be confused with a

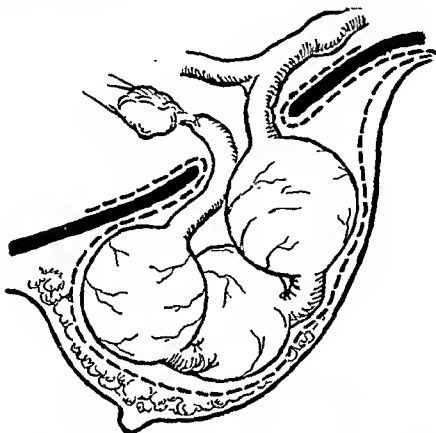


FIG. 40.—SCHEME OF INGUINAL HYSTEROCLE IN THE BITCH GRAVID WITH THREE EMBRYOS OF ABOUT 30 DAYS.



FIG. 41.—INGUINAL HYSTEROCLE IN THE BITCH.

Both cornua occupy a right-sided hernial sac. They contain partially resorbed, full term, fetuses.

mammary neoplasm or a local abscess if careful examination is made. The condition is painless and there is no systemic disturbance. Although it is tense and irreducible there is little tendency to strangulation provided intestine is not involved in addition. The latter complication is rare. In those cases in which pregnancy is advanced it will probably be possible to detect *fœtuses* on palpation.

The course of the condition depends primarily on the degree of tension in the sac and this will be influenced by its size and the number of *fœtuses* involved. A case has been seen in which the two *fœtuses* involved developed to full term and then underwent partial resorption. Another has been met in which both cornua were involved and each contained two *fœtal* units of about 30 days development. Death of the embryos with partial resorption of the placenta had occurred. The majority of cases will be presented when pregnancy has advanced about 30 days and each *fœtal* unit is about the size of a golf ball, for by this time the size of the swelling is becoming alarming to the owner.

The writer has not seen a case which has been associated with parturition nor has he seen one in which *fœtuses* were present in a herniated cornu and an abdominally situated one but they are cases which must be considered.

Surgical interference. The following alternatives present themselves.

1. Reduce the hernia, obliterate the sac and allow pregnancy to take its normal course.

In the great majority of cases it will not be possible to reduce the hernia by simple means.

2. Enlarge the hernial ring by incision of the abdominal wall and later closure by suture after reduction of the hernia. Obliterate sac; allow pregnancy to continue.

From the strictly ethical viewpoint this is the operation to select. Pregnancy is uninterrupted and the animal's full breeding powers are conserved. It presents, however, several technical difficulties—precise incision of the abdominal wall forwards from the inguinal orifice is not easy owing to the presence of the large and tensely filled sac. Moreover effective closure of the neck of the sac may be difficult after incision of the parietal peritoneum. At the same time cases will be encountered in which, after assessment of all the individual factors, this operation is selected.

3. Dissect out the hernial sac; incise its apex and expose the herniated uterus. Amputate the cornu or cornua involved. Obliterate the hernial sac. If it happens that the animal is also pregnant in an abdominally

situated horn this should not be interfered with. If, however, an abdominally situated horn is empty and it is desired that the hitch shall be sterilized, it is an easy matter after location of the bifurcation to draw this horn into the hernia and remove it. As a rule it is not possible to draw the ovaries through the inguinal ring.

This is the operation most often performed. It presents no particular difficulties and cure of the hernia is certain.

4. In those cases in which foetal development is at or approaching term, it may be decided to proceed as for 3, but instead of amputating the involved cornua to perform hysterotomy and extract the foetuses with their membranes. In the one case in which the author has performed this operation it was possible to return the uterus to the abdomen after extraction of the foetuses (Fig. 41).

Uterine Inertia

By uterine inertia is inferred the absence of, or feebleness of, uterine contractions at or subsequent to parturition. The condition is classified as primary and secondary.

Primary Inertia

This is the less common of the two varieties in animals. It is encountered most often in the dog, occasionally in the cow and sow, but is rare in the other species. It is generally ascribed to lack of tone in the uterine musculature or to degenerative changes in it. Lack of exercise during pregnancy and excessive fatness are possible causes of feeble uterine contractions at labour. Overstretching of the uterus is a cause, for inertia generally accompanies hydramnios and also the gross distension which occurs in small dogs gravid with an excessive number of young. The condition may also accompany debilitating diseases. It is possible that in some cases the essential cause lies in dysfunction of the posterior pituitary gland, for sometimes what appears to be primary inertia is met in females which are otherwise perfectly normal.

That the animal is parturient is obvious; mammary activity, pelvic changes, psychological disturbances in the bitch, and abdominal discomfort are all present. There may have been a few feeble abdominal contractions but no progress is made. In the large species, vaginal examination reveals the cervix to be dilated, the cervical mucus to have liquefied and the presence of a foetus in its membranes just in front of the pelvic brim. In the bitch it is generally possible to touch the posterior foetus with a finger in the vagina.

It is essential that treatment shall be forthcoming at the appropriate time in order to safeguard the life of the young one as well as that of the mother. It should be instituted as soon as one is satisfied that the second stage is present and that it is not proceeding normally.

In the large, uniparous species, treatment is generally simple. By vaginal manipulation the membranes are ruptured, the posture of the presented extremity corrected if necessary and the foetus delivered by gentle traction. In the bitch, however, the problem is greater, its extent depending on the number of young present in the uterus. If one only, its delivery by vectis or forceps *per vaginam* is indicated although it is probable that if the latter instrument is employed the foetus will be grossly injured. When, however, multiple foetuses are present, caesarian hysterotomy should be performed.

Pituitary extract in doses of 0.5-1.5 c.c. by intramuscular injection should be tried and even repeated but results are generally disappointing.

Primary Inertia in the Bitch Pregnant with an Abnormally Small Number of Foetuses

It is convenient to refer to this condition here as it is generally regarded as an example of primary uterine inertia. It is probable, however, that the condition results from hormone dysfunction rather than from primary uterine causes.

It is encountered in bitches gravid with one, possibly two and at the most three foetuses. Term arrives and passes without signs of labour. Mammary hypertrophy is absent or slight only and there is no tumefaction of the labiæ. The owner has often concluded, in the absence of abdominal distension, that the bitch has failed to conceive. Just how long the foetus or foetuses remain alive is not definitely known, but it is improbable it is beyond the 70th day, by which time complete separation of the decidua has occurred. From this point the fluids, membranes and soft foetal tissues undergo resorption.

In the majority of cases the cervix relaxes between the 70th and 80th days and a dark green, viscid discharge escapes from the vulva. There is still no evidence of straining. It is improbable that vaginal examination will reveal the foetus for it still occupies its original position in the cornu but it is generally possible to detect it by abdominal manipulation.

In one case recorded by the writer, parts of the single foetus occupied both cornu; the head, thorax and fore limbs being in one and the

placenta, abdomen and hind legs in the other. In another, the condition occurred in an inguinal hysterocele.

The writer has met the condition in the chow, retriever, bull-terrier and spaniel breeds.

The following exceptional case-record illustrates the condition:

Subject: A Field Spaniel in good health.

(a) At 3 years old, conceived a single fœtus which was delivered normally at term.

(b) At 7 years old, again conceived a single fœtus but term arrived and passed without signs of parturition. At 74 days the cervix was still closed and a fully developed but partially resorbed fœtus was removed by hysterotomy.

(c) At 8 years old, again pregnant with a single fœtus. Again term passed and at the 110th day, the cervix still being closed, hysterectomy was performed.

(Fœtus-membranes and fluids entirely gone and replaced by dark-brown, glutinous mucus. Fœtus shrunken, eyeballs sunken and shrunken. The abdominal cavity was empty. Pelvis occupied by the terminal rectum and urinary bladder. Diaphragm complete; heart a small fibrous sac. Unexpanded lungs almost normal.)

Treatment. Factors which will influence the treatment of such cases are: the duration of gestation and hence the state of the fœtus (es); whether the cervix has opened and if so the degree of infection which

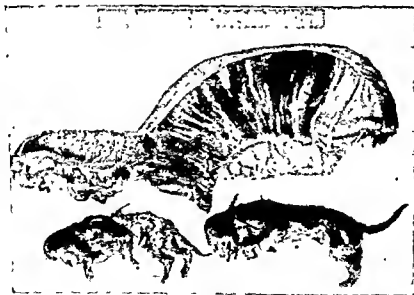


FIG. 42.—FœTAL RESORPTION IN THE BITCH.

may have supervened; the accessibility of the fœtus for forceps traction. Clearly hysterotomy is indicated in the majority but if infection has supervened hysterectomy is preferable. In the small proportion of cases in which the cervix is open and the fœtus occupies the uterine body, delivery *per vaginam* will be selected.

Secondary Inertia

This is the inertia of exhaustion and is essentially a result of rather than a cause of dystocia. Nevertheless, in multiparous species, prolonged unsuccessful efforts to deliver one foetus may result in dystocia from inertia in regard to the remainder. Secondary inertia is frequently followed by retention of the foetal membranes and retarded involution of the uterus, factors which predispose to puerperal metritis.

Secondary inertia is met with in all species and, speaking generally, is a preventable condition. Its prevention depends on the early recognition that labour has ceased to be normal and the application of the appropriate assistance.

In some breeds of dog of which the Scottish terrier is the outstanding example, inertia may supervene early and before the expenditure of effort it is reasonable to expect from a healthy bitch. The general history of such a case is as follows:

The bitch is heavily gravid; the gestational period is normal. One or two foetuses have been expelled without exceptional difficulty. From this point all signs of labour cease and the bitch is content to lie suckling the young already born yet it is obvious that the greater part of the litter has still to be expelled. No further progress is made, and if appropriate treatment is not forthcoming the foetuses will die, infection of the uterus and toxæmia develop and the bitch succumb.

Sometimes the case conforms with the description given for primary inertia—a short, feeble effort is the sole indication of labour. A similar picture is frequently seen in the toy Dachshund.

Treatment. In the uniparous species, correction of the dystocia which provoked the inertia is the essential feature of treatment. In the multiparous species, management of the case will depend on the duration of labour, the number of foetuses still unborn and their condition, and the degree of uterine infection. In an early case, delivery of the foetus causing the primary dystocia may be followed after a few hours by a return of uterine contractions and parturition may proceed without further hindrance. Such is often the case in the sow and occasionally in the bitch and cat. When the case is of longer duration and there are still several young to be born it is best to proceed with the delivery of the remainder. In the sow it is often possible to do this with the hand inserted into the uterus *per vaginam*. In the bitch it may be decided to attempt forceps delivery. But the protracted use of forceps when three or four foetuses remain unborn has very little to commend it. The foetuses occupy the cornua beyond the safe reach of the forceps and “blind

“fishing” is likely to result in uterine rupture. Better results attend laparotomy. If the case is not of more than 12 hours' duration since the onset of second stage labour, hysterotomy is the operation of choice, for not only is the interference of less magnitude than hysterectomy but the animal's breeding function is preserved and the prognosis is good. If, however, the case is of longer duration and the fetuses are dead and putrefaction has commenced, hysterectomy should be resorted to for in these instances the more simple hysterotomy is attended by a high mortality from post-operative peritonitis. The prognosis after hysterectomy will depend chiefly on the animal's state of health at the time of operation, but if performed up to 24 hours after the onset of labour will be attended by a high recovery rate.

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CHAPTER 7

FETAL DYSTOCIA

WHILE we have seen fit to refer to maternal abnormalities in the causation of dystocia first, it must be understood that foetal irregularities form the commoner cause of difficult birth in the domestic species. The foetal irregularities encountered are basically the same in all species, but certain forms, dependent generally on the anatomical form of the species, are more common in some than others. In the foal, calf and lamb the relative length of the limbs is a frequent cause of obstructive dystocia, whereas in the piglet, puppy and kitten the limbs are of less significance.

Foetal dystocia may be divided primarily under two headings:

- (1) That arising from disproportion in the size of the foetus to that of the maternal birth canal. Such disproportion may occur in a normal or pathological foetus.
- (2) That resulting from abnormalities in the presentation of the foetus at the maternal pelvic inlet.

To these must be added, in cases of twinning in ruminants, the simultaneous presentation of parts of two foetuses.

Discussion on the Fundamental Causes of Foetal Dystocia

The dimensions of the non-dilatable maternal pelvic inlet are such that the normal full-term foetus is just able to navigate it, but to do so it is necessary that the foetus shall approach it in an exact manner so that it offers the least possible obstruction. This statement certainly holds true for the uniparous species, for in these any presentation other than the anterior one (the foetal head directed towards the maternal pelvis) with the head and fore-limbs extended is likely to result in dystocia. In the multiparous species this relationship is not so exact and there is generally more room in the pelvis for the passage of the young, with the result that the disposition of the comparatively small foetal limbs is less important and many piglets and puppies are delivered normally with their limbs in positions which would have caused dystocia in the foal and calf. But on this point the writer must not be dogmatic, for when a female of a multiparous species is gravid with an abnormally

low number of fœtuses they may be relatively oversized and malposition of the limbs may be the factor which provokes dystocia.

Under conditions of domestication animals attain sexual maturity before they have reached full physical development. This is most noticeable in the bovine. It is the custom in this country to mate heifers of the dairy breeds when they are about $1\frac{1}{2}$ years old, and it is surprising that although they are far from mature physically when parturition time arrives at $2\frac{1}{4}$ years, the incidence of dystocia from oversize of the fœtus is relatively low. It is to be noted that the newborn of such a mother is generally considerably smaller than that of her older and physically mature sister (in the 60–70 lb. range). Nevertheless, calves when running with a young bull frequently conceive at ages of from 9–12 months and the incidence of dystocia in mothers of 18–20 months, due to smallness of the pelvis, vagina and vulva, is high. Most of the phenomenally large calves (100 lb. and over), are born of aged multi-gravida, but in this connection also there are exceptions, for in the Friesian and Red Poll breeds a high incidence of fœtal oversize in heifer mothers is encountered and it is assumed that genetic factors are responsible.

Knapp, Lambert and Black (1941), recording 297 observed parturitions in Shorthorns, found the average birthweight of the calf to be 69.2 lb. in the beef breed and 79.2 lb. in the dairy breed. The average gestational period was 281 days, with a range of 260–300 days; the majority being between 280 and 284 days. First calves were considerably lighter than subsequent ones. There was a definite increase in birthweight associated with the longer gestational periods.

It is the common belief that the mating of a large male with a small female is a cause of oversize of the resulting fœtus. This has not been the writer's experience in the bovine, while in the mare, females of the small breeds are frequently mated to males of the large heavy ones without any significant rise in the incidence of dystocia. In so far as the bitch is concerned, dystocia from oversize is much more likely to arise from an abnormally small litter than from disproportion between the sizes of the sire and dam.

In sheep the development of breeds with large heads has become a cause of dystocia when males of these species are crossed with females of smaller breeds, while in the dog the development of grossly brachycephalic and often achondroplastic types has resulted in a relatively high incidence of dystocia in such breeds as the bulldog, Pekingesec, and Boston terrier.

The question arises—is posterior presentation (the fœtal hind

extremity directed towards the maternal pelvis) normal? Many young are certainly born in this position without assistance. The condition occurs often in the multiparous species, and in the dog the author's observations indicate it to be as high as 30 per cent. It is much less common in the uniparous species, but is more frequent in the cow and ewe than in the mare. The relative incidence of dystocia is higher in posterior presentation than in anterior. A consideration of the course of parturition would indicate that posterior presentation is abnormal. In anterior presentation the foetus is wedge-shaped and this serves progressively to dilate the birth canal during its passage, whereas in posterior presentation compression of the foetal abdomen causes expansion of the ribs and the costal arch engages abruptly. Again, the foetal occiput, often the broadest bony foetal part, makes an abrupt engagement. Thirdly, the passage of the foetus is against the general direction of its hair, while finally, more space is required for the hind limbs to undergo full extension than is the case with the fore. Not the least of the numerous complex mechanisms which control reproduction is that which ensures that the foetus in its final stages of development shall lie with its anterior extremity towards the maternal pelvic inlet.

During intra-uterine life the foetus adapts itself to the shape of the uterus; its vertebral column is adjacent to the greater curvature of the uterus and its movable extremities are arranged so as to occupy the least possible space. The limbs are flexed, as also may be the occipito-atlantal articulation. In those species in which the greater curvature of the uterus is directed downwards, it is necessary for the foetus to undergo progressive rotation during the course of parturition from the ventral to the dorsal position, while in all the uniparous species it is necessary that the fore limbs and head shall be extended before the foetus engages the pelvis. This latter movement requires a considerable amount of space and thus it appears that during the first stage of labour the foetus tends to sink towards the apex of the gravid cornu in order that this extension shall occur. Again the complexity of the mechanism is impressive.

An appreciation of these points makes most forms of foetal dystocia readily understandable. For some reason the mechanism breaks down: under the influence of forceful uterine contractions the foetus is pressed against the pelvic inlet before this change of posture has occurred, and one of the common forms of dystocia results: e.g. flexion of the limbs at the carpus, shoulder, tarsus or hip; downward displacement of the head.

Departures from longitudinal presentation and from the dorsal position are uncommon in ruminants. This is readily understandable

when one considers the anatomical arrangement of the cornua and the position the uterus occupies during pregnancy. Presentations in the ventral and lateral positions are comparatively common in the mare and bitch, and it is suggested that they result from failure of the foetus to undergo complete rotation during the process of delivery. Bicornual and transverse presentations are essentially equine abnormalities, although they are occasionally encountered in the cow and the bitch pregnant with one foetus. The great size of the uterine body in the mare is the obvious explanation.

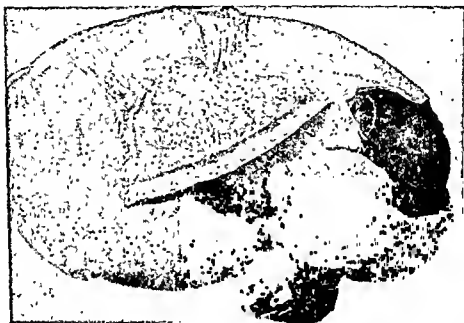


FIG. 43.—FIXED SPECIMEN OF PREGNANT BOVINE UTERUS APPROACHING TERM.
The disposition of the foetus within the uterus is demonstrated.

From the foregoing it will be gathered that in the writer's view most cases of foetal dystocia arise during the early stages of labour and result from errors in deformation of the foetus. He does not believe that they are predetermined by morbid conditions within the uterus or that they can be prevented.

A foetal abnormality which deserves special consideration is lateral deviation of the head, for it is improbable that it is explained by the hypothesis just expounded. The condition is met with in all species. The writer has on a number of occasions in the cow, sow, bitch and cat seen the condition at post-mortem examinations carried out in the later stages of pregnancy. In the multiparous species it is the foetuses occupying the terminations of the cornua which are most often involved, and it is suggested that lack of space is the cause (Fig. 218). Whether lack of

space is the causal factor in the uniparous mare and cow is not known, but the point it is wished to stress is that it is an abnormality which develops during gestation rather than at parturition. When the condition involves a *fœtus* which is presented posteriorly its existence is unknown, for it corrects itself spontaneously during passage through the pelvis.

The Common Forms of Fœtal Dystocia

THE MARE

In the mare, most cases of dystocia result from abnormalities in the presentation or position of the *fœtus* or postural irregularities of its head or limbs. Disproportion in the size of the *fœtus* to the maternal pelvis and monster formation are rare.

Transverse presentation is common: the *fœtus* may be disposed with its head and limbs (ventro-transverse) or its vertebral column (dorso-transverse) directed towards the pelvis. In the majority of such presentations the *fœtus* occupies the uterine body and is found on examination to be adjacent to the pelvic inlet, in fact, in ventro-transverse cases the head and limbs may occupy the vagina. There is, however, another form of transverse presentation in which parts of the *fœtus* occupy both cornua (bi-cornual pregnancy), its trunk traversing the anterior part of the uterine body. Not infrequently this form is complicated by ventral deviation of the uterus. Another relatively common abnormality of presentation is that the *fœtus* occupies an approximately vertical position in the uterus with its head uppermost and its limbs directed towards the pelvis (dog-sitting position).

Failure of the *fœtus* to rotate into the dorsal position and its consequent engagement at the pelvis in the ventral or lateral position is often encountered. It occurs in anterior and posterior presentation and may be complicated by laceration of the dorsal wall of the vagina and even the rectum and anus.

All forms of postural irregularity occur in the mare. The head and neck may be displaced laterally, or downwards between the forelegs. Such displacement may be further complicated by rotation of the cervical joints. The limbs are frequently presented abnormally; one, several or all of the joints of the limbs may be flexed, and the irregularities are classified according to their clinical significance as carpal flexion, elbow flexion, shoulder flexion, hock flexion and hip flexion. Bilateral hip flexion is known as breech presentation. An exceptional postural abnormality which occurs in anterior presentation is displace-

ment of one or both extended fore limbs above the fœtal neck (foot-nape posture).

Not infrequently many of the abnormalities just described are further complicated by impaction of the presented parts in the pelvis.

THE COW

In the cow both relative and absolute oversize of the fœtus are common. Oversize of an otherwise normal calf may be encountered in all breeds and in primigravida and multigravida, but the writer's experience has been that the condition is more common in the Friesian and Red Poll breeds than others and that male calves are more often involved. Oversize due to emphysema of the fœtus is common, but this is the outcome of, rather than the primary cause of dystocia. Oversize due to local or general œdema of the fœtus, while occurring, is relatively uncommon. The incidence of monsters is high in the cow; they are generally of the distorted and celosomian types, *Schistosomus reflexus* and *Perosomus elumbis* being commonest. Achondroplastic calves are also encountered; the so-called bulldog calf of the Dexter-Kerry breed being the most common. Departures from the longitudinal presentation occur, but are uncommon. The anatomical arrangement of the cornua and the absence of a distinct uterine body do not favour transverse presentations, and such are, in fact, rare. Krill (1938), however, has recorded two authenticated cases of bicornual gestation in the cow in which presentation was dorsotransverse. Postural irregularities of the head and limbs are common and in the main are the same as those described for the mare. The simultaneous presentation of twins is an occasional cause of dystocia, and one of the first duties of the obstetrician when proceeding to manipulative delivery is to satisfy himself that the presented limbs belong to the same fœtus.

Tutt (1944) has recorded ninety-seven consecutive cases of bovine dystocia encountered by him in practice in Hampshire, and they afford valuable material for study. Maternal factors were responsible for 14·5 per cent. and fœtal causes for 85·5 per cent. Of the maternal causes, uterine torsion headed the list, followed by immature pelvis with smallness of the vagina and vulva, incomplete dilatation of the cervix, and fibrous hymen. In the fœtal group postural abnormalities were by far the commonest; others were oversize of the fœtus and monstrosities. In anteriorly presented fœtuses, lateral deviation of the head was the commonest irregularity, followed by carpal flexion, elbow flexion and shoulder flexion. Not infrequently more than one postural defect

occurred in the same individual. In posterior presentation, hock flexion occurred most often, followed by hip flexion. Limb flexions were more often bilateral than unilateral. Two transverse presentations were included, both being of the ventro-transverse type. Of the monstrosities, schistosomus, schistocormus, limb contractures, joint anchyloses, and anasarca were encountered.

THE EWE

The picture of foetal dystocia in the ewe closely resembles that seen in the cow. Postural abnormalities are very common, particularly in ewes pregnant with more than one foetus; moreover, multiparity is often associated with the simultaneous presentation of parts of more than one foetus. Developmental irregularities are relatively common and all types may be encountered. Gross oversize of the foetus, other than the outcome of foetal oedema or putrefactive emphysema, is uncommon, but relative oversize of the head is common in certain forms of cross breeding.

THE SOW

The types of foetal dystocia encountered in the sow resemble more closely those of the bitch than those of the uniparous species. Attention has already been drawn to uterine inertia and pelvic injuries as causes of maternal dystocia in this species.

The incidence of foetal dystocia increases when the litter is small, for in these the size of the individual tends to be large and obstruction may result. Irregularities of limb posture and even uncomplicated posterior presentation often cause dystocia when the litter is small, whereas had the litter been a large one and its individuals small, these irregularities would not have interfered with normal expulsion. Monsters are not uncommon; they are generally of the double type.

THE BITCH

Absolute oversize of the foetus is commonly encountered in bitches gravid with one or two young only; it may also result from a pathological foetus. Relative oversize also is comparatively common. It is most often met in the small breeds, for in these there is often considerable variation in the sizes of the respective individuals of a litter (Table 8). A primigravid bitch often has trouble with her first puppy from this cause, but provided timely assistance is forthcoming she generally expels the remainder of her litter normally. If, however, assistance is delayed the onset of inertia may make the outcome grave. Oversize of the head is common in the grossly brachycephalic breeds.

Irregularities of limb posture are generally of little importance provided the puppy is of normal size, in fact many puppies are born with their fore or hind limbs flexed. When, however, the fœtus is relatively large these irregularities are often the factor which provokes dystocia. Not infrequently a bitch or a cat, in attempting to expel a fœtus with its fore limbs retained, partially succeeds only in that the head is born but the thorax with the limbs have become obstructed at the maternal pelvic inlet. Similarly a puppy or a kitten may have its hind parts born while its distended thorax is obstructed.

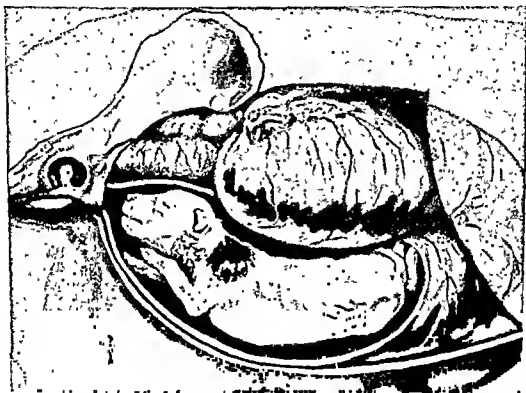


FIG. 44.—SCHEME OF FIRST STAGE OF LABOUR IN THE BITCH.

Irregularities of head posture are common and vertex ("butt") presentation and lateral deviation of the head are frequently encountered (Figs. 45 and 46). An interesting feature of the latter abnormality is that it often involves the last puppy to be born.

Fœtal hydrocephalus and anasarca are occasionally met, but other forms of monster are rare. In the achondroplastic types and in the kitten, gross umbilical hernia is seen, but it is seldom a cause of dystocia.

Abnormalities of position are common both in anterior and posterior presentation and are themselves a cause of obstructive dystocia. Failure of the fœtus to rotate prior to presentation results in its engaging in the pelvic inlet in the ventral or lateral position.

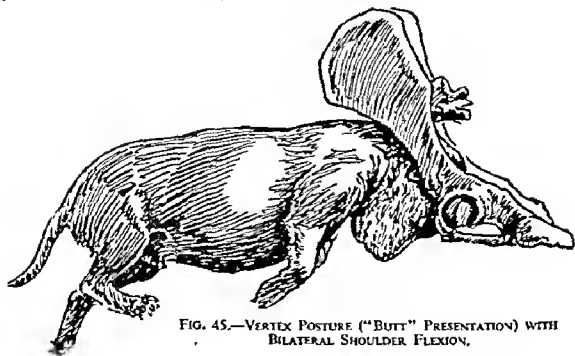


FIG. 45.—VERTEX POSTURE ("BUTT" PRESENTATION) WITH
BILATERAL SHOULDER FLEXION.

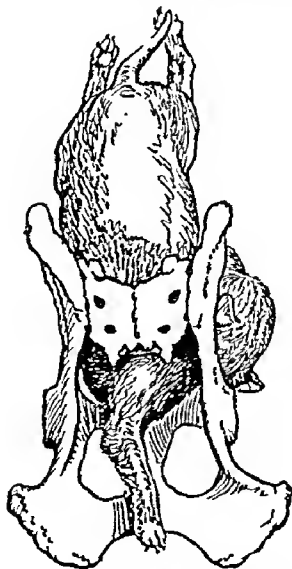


FIG. 46.—LATERAL DEVIATION OF THE HEAD (SHOULDER PRESENTATION).

TABLE 6
Pelvic Dimensions—Bitch

Weight of bitch, lb.	Breed	Parous or not	Pelvic Inlet		Across Iliac Crests, mm.	Across Ischial Tuberosities, mm.
			Sacro-pubic, mm.	Bisiliac, mm.		
5	Manchester	P	32	30	40	59
11	Pekingese	N	37	39	62	62
12	Mongrel	N	42	35	59	63
12	Pom	N	40	32	48	60
14	Terrier	N	45	38	68	73
17	Terrier	N	43	41	62	72
18	Terrier	P	48	42	62	82
24	Terrier (fat)	N	49	40	65	70
25	Sealyham	P	44	49	70	80
37	Bull-terrier	N	48	47	85	91
60	Airedale	P	58	50	100	105

It will be noticed that in all the specimens except those obtained from the achondroplastic types, Pekingese and Sealyham, the sacro-pubic dimension exceeds the bisiliac.

TABLE 7
Dimensions of Puppies at Birth

Breed	Weight of puppy, oz.	Head		Chest		Hips	Remarks
		Lateral	Dorso-ventral	Across Shoulders	Dorso-ventral		
Toy Dachshund.	5	mm. 30	mm. 32	mm. 29	mm. 35	mm. 28	
Terrier ..	5½	29	34	32	38	26	
Mongrel ..	5½	28	30	32	28	23	
Spaniel ..	6½	32	32	32	42	30	
Terrier ..	6½	30	32	34	38	24	
W. Highland	7	36	37	37	34	32	
X-bred Pom	7½	30	30	34	36	28	
Mongrel ..	8½	32	32	38	35	28	
Spaniel ..	9	38	38	34	44	34	
Spaniel ..	9	34	34	34	48	28	
Mongrel ..	9½	31	—	32	—	28	
Mongrel ..	9½	32	32	38	48	32	
Mongrel ..	9½	30	32	34	40	20	
Mongrel ..	10½	33	34	42	48	32	
Mongrel ..	10½	35	35	46	50	32	
Spaniel ..	11	34	36	42	48	32	
Mongrel ..	12	32	34	48	46	36	

Dystocia.

Dystocia breech, 37 mm. at obstruction.

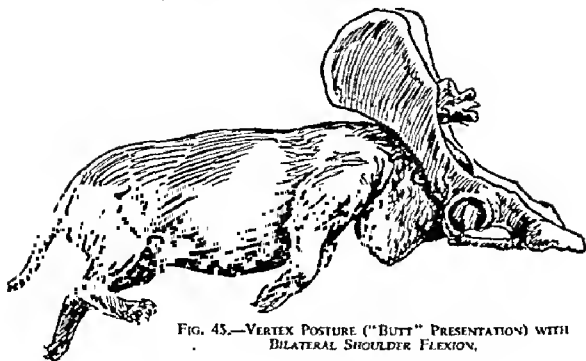


FIG. 45.—VERTEX POSTURE ("BUTT" PRESENTATION) WITH
BILATERAL SHOULDER FLEXION.

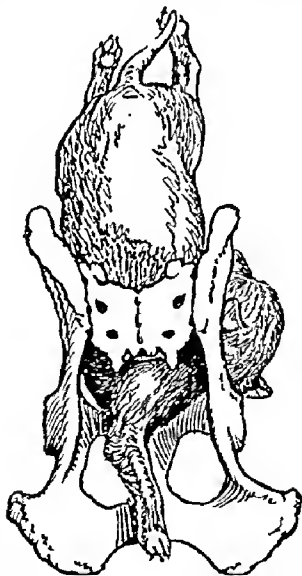


FIG. 46.—LATERAL DEVIATION OF THE HEAD (SHOULDER PRESENTATION).

TABLE 8—continued
Parturition Data—Bitch

Animal	Weight of bitch, lb. and oz.		Period of Gestation, days	Weight of Puppies, oz.								Remarks	
	Before	After Parturition		1st	2nd	3rd	4th	5th	6th	7th	8th		9th
4½ y.o. mongrel Pom (prim.) ..	21	17	59	M. 9	F. 8½	F. 7½	F. 6						Normal parturition. Pelvic inlet narrow, old fracture.
5 y.o. Sealyham (multip.) ..	29	25		M. 9	M. 8½	M. 8	F. 7	F. 6½					Dystocia; stricture cervix. Metrectomy.
1 y.o. spaniel (prim.) ..	29	22-7	66	F.* 8	M. 8	M. 9	F. 10	F. 9	F. 8	M. 7			Normal parturition, 4 hours.
3 y.o. spaniel (prim.) ..	33-4	28	62	F. 9	F. 11	F. 9½	M. 9	M. 9	F. 6½	M. 6½			Normal parturition, 6½ hours.
9 m. mongrel (prim.) ..	36-9	29	63	M. 12	F. 10½	F. 8½	F. 9½	F. 10½	F. 5½				Normal parturition, 4½ hours.
2 y.o. spaniel (prim.) ..		27	58	F. 11	M. 10	M. 12	M. 11	M. 10	M. 10	M. 10	F. 11	F. 10	Normal parturition, 8 hours.

* Order of puppies not known.

TABLE 8
Parturition Data—Blich

Animal	Weight of bitch, lb. and oz.		Period of Gestation, days	Weight of Puppies, oz.									Remarks
	Before Parturition	After Parturition		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	
6½ y.o. toy Dachshund (multip.)	12-7	10-2	60	F. 6	M. 5	M. 6	F. 6	M. 6	Fatal death at 8th week				Normal parturition, 9 hours.
2 y.o. mongrel (prima.) ..	14	10			M. 9½	M. 9½	M. 7½						Dystocia, big fetus and breech. Metrectomy.
4 y.o. Pekc (multip.) ..	14-2	12-6	64	M. 5	F. 5½								Normal parturition, 4½ hours.
1½ y.o. terrier (prima.) ..	14	11		M. 5½	M. 7½	M. 6½	F. 6½						Metrectomy at 60th day; fracture pelvis.
1½ y.o. W. Highland (prim.) ..	17	15-8	60	M. 7½	F. 7								Dystocia; uterine inertia. Forceps delivery.
8 y.o. Shetland collie (multip.)	20-14	19		F. 8½	F. 6½	Fatal death at 6th week							Dystocia. "Butt" presentation. In labour, 3 days. Metrectomy.

CHAPTER 8

THE APPROACH TO AN OBSTETRICAL CASE

History of the Case

BEFORE proceeding to interfere with the animal, a comprehensive history of the case should, whenever possible, be obtained. Much of it will be the outcome of questioning of the attendant, but many points also will be elicited from personal observation of the animal.

Has full term arrived or is delivery premature?

Is the animal a primigravida or multigravida?

What is her previous breeding history?

What has been the general management during pregnancy?

When did straining first commence; what was its nature—slight and intermittent or frequent and forceful?

Has straining ceased?

Has a water-bag appeared and if so when was it first seen?

Has there been any escape of fluid?

Have any parts of the foetus appeared at the vulva?

Has an examination been made and has assistance been attempted; if so, its nature?

In the case of the multiparous species, have any young been born, naturally or otherwise, and if so, when? Were they alive at birth?

Is the animal still taking food?

In the case of the bitch and cat, has there been vomiting?

By a consideration of the answers to these and similar questions it is possible to form a fairly accurate idea of the case to be dealt with. The inference to be drawn from many of them is obvious, but there are several points associated with them which merit discussion. The greatest attention will be paid to the duration of labour. If the animal, particularly a heifer, has been exhibiting slight and occasional efforts only and there has been no appearance of the water-bag, it is probable that the second stage of labour has not yet commenced and that parturition will proceed normally. The onset, however, of vigorous and frequent straining together with the appearance of the amniotic sac indicates that the second stage of delivery has commenced, and if several hours have elapsed since its onset, it is reasonably certain that obstructive

Transverse presentation is rare. When it occurs the bitch is generally gravid with a single foetus only and gestation is of the bicornual type. It is generally accompanied by uterine inertia.

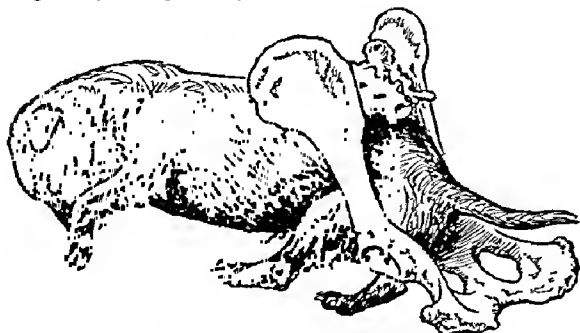


FIG. 47.—BILATERAL HIP FLEXION POSTURE (BREICH PRESENTATION).

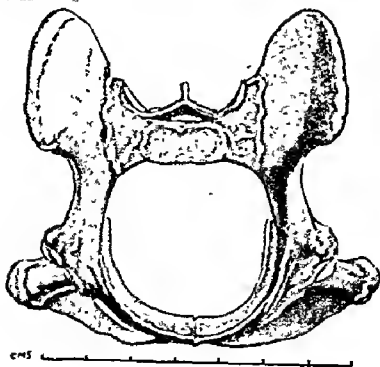


FIG. 48.—THE PELVIC INLET OF THE BITCH.
Specimen obtained from a 20-lb. animal.

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vaginal examination should be considered. In this way the risk of infecting the neural canal should spinal anæsthesia later be found to be necessary is reduced.

When dealing with the bitch and cat, the degree of abdominal distension should be observed, for it is thus possible to make an estimate of the number of foetuses which occupy the uterus. The onset of vomiting together with a great increase in thirst should be regarded as grave signs in the bitch.

Detailed Examination of the Animal

Large animals. The animal should be effectively restrained with a man at its head and its right side pressed firmly against a partition. In the case of the mare, a twitch should be applied and a fore-limb raised until one is satisfied as to the animal's temperament and likely behaviour. Several clean buckets full of hot water with soap should be available, and arrangements made for a table, bench, or truss of straw on which to lay out instruments to be suitably placed. A plentiful supply of clean straw should be placed under and behind the animal.

With an assistant holding the tail to one side, the external genitalia and the surrounding parts are thoroughly washed. The operator, having washed and lathered his hands and arms, proceeds to make a vaginal examination. The introduction of the hand through the vulval labiæ almost invariably provokes defecation in the cow and it becomes necessary to wash the vulva again.

Without the previous induction of epidural anæsthesia and the resultant paralysis of the rectum, it is almost impossible to make a vaginal examination in the cow without introducing some faeces. This statement certainly holds true for animals which have been fed on grass and in which faeces are semi-fluid. Nevertheless it may be taken that such material is not highly infective and no serious consequence will result from this contamination of the vaginal mucus membrane provided the latter is intact.

To proceed to a consideration of a recent case. If the vagina is found to be empty, attention should be directed to the cervix. Is it completely obliterated? If it is not and is still occupied by some sticky mucus, it may be concluded that the second stage of labour has not yet commenced and the animal should be given more time. Maybe the case is one of uterine torsion. Does the vagina end abruptly at the pelvic brim and is the mucosa drawn into tight, spirally arranged folds? In the

dystocia exists. Nevertheless it is probable in all species except the mare that the foetus or foetuses are still living. In the primigravida, particularly the heifer and the bitch, it is often found that the cause of the dystocia is relatively simple, such as slight oversize of the foetus, and the application of a little assistance is all that is required. In the mare, the normal course of delivery is so rapid and separation of the placenta occurs so quickly once the second stage has commenced, that any delay generally results in the death of the young one.

When, however, the call for assistance has been delayed twenty-four or more hours and it is noticed that straining efforts have ceased, it may be taken that the foetus is dead, much of the fluid has been lost, the uterus is exhausted and that putrefaction of the foetus has commenced. These facts in themselves, quite apart from the more detailed features of the case, indicate that the prognosis must be guarded. This is especially the case in the multiparous species for it is probable that there are several foetuses *in utero*.

If the history is that efforts to deliver the animal have already been made, or when such evidence is absent but one suspects it to be the case, a search for injury of the genital canal will be the first feature of the detailed examination of the animal.

General Examination of the Animal

The animal's physical and general condition should be noted. If recumbent, is she merely resting or is she exhausted? Body temperature and pulse rate should be noted and the significance of abnormalities considered. Particular attention should be paid to the vulva. Parts of a foetus may be protruding and it may be possible to assess the nature of the dystocia from these. Are exposed foetal parts moist or dry? Such evidence serves not only as a guide to the duration of the condition but also to the effort that will be necessary to correct it. Should parts of the amnion protrude, what is their condition? Are they moist and glistening and is fluid caught up in their folds? If so, their exposure is recent and the case is an early one. If, however, the membranes are dry and dark in colour, it may be taken that the case is protracted. Maybe nothing protrudes from the vulva. Particular attention should be paid to the nature of the discharge. Blood, especially if profuse, generally indicates recent injury to the birth canal. A dark brown, foetid discharge indicates a grossly delayed case. In cases in which it is clear from the evidence already adduced that the foetus is dead and the uterus grossly infected, the desirability of inducing epidural anaesthesia before proceeding to a

fœtal parts becoming dry. Contraction of the uterus directly on the irregular contour of the fœtus makes retropulsion difficult or even impossible, while in many cases the fœtus has become impacted in the pelvis.

The bitch. Examination should if possible be carried out in a room where running water and a wash-basin are available. The bitch, unless an exceptionally large one, should be placed standing on a table which is covered by several layers of clean newspaper, and a noose applied to her jaws. It is preferable that a person with whom the animal is familiar should hold its head.

As a general rule, the operator will proceed to make a digital examination *per vaginam*, especially in early cases in which it is likely that obstruction is the cause of the delay and also in protracted ones in which it is estimated that a single fœtus only remains unborn. Nevertheless, cases will be met, in which it is obvious that inertia has supervened and there are several fœtuses to be delivered, in which immediate cæsarian section or hysterectomy is indicated.

Whether or not the hair is clipped from the area around the vulva before making a vaginal examination will depend on the length of the coat. In long-coated animals it is a great convenience to do so, and although it is impossible to render the area sterile, it should be thoroughly washed with hot water and soap.

Sometimes on raising the tail it is seen that part of a fœtus—a head or hind parts, is outside the vulva. Such a finding is more common in the cat than the bitch. The case is a simple one: traction on the exposed parts effects delivery without difficulty, and provided this assistance has been forthcoming early, it is probable that parturition will proceed normally. Occasionally it is found that the vagina is occupied by a fœtal head or buttocks which have become impacted. In the majority, however, the pelvic canal is unoccupied and obstruction occurs at the inlet.

What is the presentation? If a head, can one detect the mouth? Or is it the occiput with the ears? If the latter, the case is one of vertex presentation. Maybe a single limb is felt, but there is no sign of the head: the case is probably one of lateral deviation of the head. Is the presentation posterior? Recognition of the tail is generally simple, although it may be directed forwards over the fœtal back. Have the hind limbs entered the pelvis or are they retained? Has the fœtus rotated into the dorsal position or is the case one of ventral or lateral position? Is the uterine body unoccupied?

event of the vagina being occupied by amnion only, the nature of the foetal parts presented at the pelvic inlet must be ascertained. Can a foetal tail and anus be identified? If so it is highly probable that the case is one of breech presentation. Is it the flexed neck which is being palpated? Can the mane be detected? A search on one or other side may reveal the ears and occiput, the case being one of lateral deviation of the head. But what of the fore-limbs? Can the flexed carpi be felt beneath the neck or is there complete retention of the fore-limbs in addition to the head abnormality? In the mare complete emptiness of the vagina apart from membranes may be due to postural defects, as previously outlined, but more often indicates a dorso-transverse presentation. If it is impossible or almost impossible to reach any parts of the foetus in this species, the case is probably one of bi-cornual gestation.

But in the majority of cases some part of the foetus occupies the vagina—the head, a limb or limbs. Recognition of the head is not difficult: the mouth and tongue, the orbits and the ears are generally obvious. In the case of a limb, the first requirement is to ascertain whether it is a fore or hind. If the plantar aspect of the digit is downwards, it is highly probable that it is a fore-limb and the converse is equally true. This statement applies with greater force to the cow than the mare, for in the latter presentation of the foetus in the ventral position is relatively common. Proof is obtained by noting the direction of flexion of the limb joints. If the joint immediately above the fetlock flexes in the same direction as the latter, the limb is a fore one and the converse. The beginner may experience some difficulty in recognizing the foetal parts he is palpating if they are covered by amnion. To overcome this, he should first pick up and open the torn edges of the amniotic sac and pass his hand into it so that his fingers come into direct contact with the foetus. If two limbs are present, it must be ensured that they belong to the same extremity and to the same foetus.

Not infrequently it is necessary to repel the foetus in the uterus to ascertain the nature and direction of displaced parts. If continued straining makes this difficult, the induction of epidural anaesthesia should be considered at once.

In the protracted case, assessment of the exact nature of the dystocia and methods of correction may be more difficult. Often, and particularly in the case of the heifer, the vaginal mucus membrane has become grossly swollen and there is no room in which to carry out manipulations. Loss of fluid has resulted in the mucous membrane and the

ment occurs. If the mother survives, deformity of the perineum, fistula of the vagina and rectum, or paralysis may ensue. There are, of course, many malpresentations in which delivery without correction is manifestly impossible and the application of traction to these makes confusion worse confounded. Finally, delivery by abdominal section must be considered. The author knows of no records of caesarian section in the mare. The operation has a definite place in bovine obstetrics and when delivery by other means is impossible, it should be performed. The ewe, particularly one pregnant with multiple fœtuses, is a bad subject for caesarian section. In the sow hysterotomy may be performed with a good expectancy of saving the mother, while in the bitch and cat caesarian operations have a prominent place in obstetrics.

Special

THE MARE

The first consideration is—shall attempts at correction be made with the animal standing or shall she first be cast, restrained and narcotized? The decision will be influenced in part by the size and temperament of the mare, but more especially by the type of dystocia. Not infrequently the operator commences manipulative correction with the mare standing, but soon realizes that if he is to succeed recumbency with narcosis and possibly anterior epidural anæsthesia will be necessary. It is important in such cases that this decision shall be made early so that the obstetrician shall not have become exhausted as the result of prolonged but futile efforts. If operation is to be performed in the standing position, the induction of posterior epidural anæsthesia should be considered, particularly if efforts at correction are negatived by the vigorous straining of the mare. It is important, however, that the quantity of anæsthetic solution injected shall not be such as seriously to impair the action of the hind limbs, for a partial motor paralysis may result in serious injury to the animal (see Chapter 11). Relatively simple abnormalities, such as carpal flexion, lateral or downwards deviation of the head, can often be corrected using the hand alone, particularly when the mare is comparatively small and straining has been eliminated. When, however, one of the more difficult forms, such as transverse presentation, impaction of the fœtus in the pelvis, or when there is laceration of the vagina or vulva, it is generally best to cast and narcotize the animal at the outset. One of the advantages of recumbency is that by changing the position of the mare the weight of the fœtus can be utilized to facilitate correction. Whenever intra-uterine embryotomy

Consideration of Treatment to be Adopted

General

The great majority of dystocia cases in all species, with the possible exception of the dog, are foetal in type and are the outcome of malpresentation or oversize. In malpresentation, the first aim of treatment is to convert it into normal, anterior or posterior presentation, and having done this hasten delivery by relatively gentle traction. Whenever the foetus is living, such correction must, if possible, be performed by manipulation, assisted perhaps by the use of simple instruments such as snares and repellers. In cases of oversize of the foetus, delivery by traction is the first consideration. In many in which its degree is relatively slight, delivery by strong but controlled traction can generally be effected without serious injury either to the mother or offspring. When it is impossible to correct a malpresentation or when the foetus is grossly oversized or deformed and delivery by the simple procedures previously mentioned is impossible, embryotomy calls for consideration. Embryotomy may be directed at the removal of one or more movable foetal parts or it may comprise systematic cutting up of the foetal trunk. In the large, uniparous species embryotomy, speaking as a general rule, should always be considered before resorting to laparotomy; but by its adoption the foetus if alive is sacrificed and exceptional cases will be encountered in which the potential value of the young one is greater than that of the mother, and laparotomy is indicated. In Germany attention has been paid to "humane" methods of killing the foetus before commencing embryotomy. Such is presumably based on the belief that the unborn young one is capable of appreciating pain. This would seem unlikely, for Barcroft (1941) noted that the carotid artery of the full-term foetus (sheep) was only half saturated with oxygen. Such an oxygen supply is adequate only for existence, reflexes are of a low order and movement random. Finally the use of uncontrolled, forcible traction using pulleys or "obstetrical machines" has to be considered in certain malpresentations and in cases of grossly oversized but otherwise normal foetuses. Such methods are sometimes resorted to in the mare in certain malpresentations in which it is just possible that powerful traction will bring about delivery. Such treatment is only permissible when after careful examination it is concluded that the foetus is relatively small and the mother "roomy." Nevertheless, in many cases in which delivery is eventually effected by this means, maternal soft parts are grossly lacerated, pelvic nerves are severely contused and occasionally sacral displace-

is normal and that obstruction is due to slight oversize. In these it is a comparatively simple matter to apply snares to the extremities and, following the principles which are described in detail in later chapters, effect delivery by traction. As a rule the animal remains standing during the application of snares but often goes down during the passage of the calf through the vulva. In the multigravid cow, while oversize is often encountered, it is more likely that the cause of obstruction is malpresentation. If it is found that the space required for correction is continually lost due to straining, epidural anæsthesia should be adopted without further waste of effort. In the majority the posterior type will suffice. It is preferable in all relatively simple cases to employ posterior rather than anterior anæsthesia, for the animal is still able to stand under its influence and, speaking generally, reposition is easier in the standing than in the recumbent position. A further advantage of epidural anæsthesia is that an animal which has become recumbent often rises again after its induction.

If the calf is a monster, it is almost certain that embryotomy will be necessary before it can be delivered via the vagina. In many, especially schistosomus reflexus in which the head and limbs are directed towards the pelvic inlet, embryotomy may fail and the only possible means of removing the fœtus is by laparo-hysterotomy.

In cases of gross oversize of an otherwise normal calf presented normally, the inclination of the operator will be to resort to forced traction. In many cases this attitude is a proper one, for by this means delivery is often effected without the mother sustaining irreparable injury. Nevertheless, the operation is largely uncontrolled and as it is impossible accurately to assess the size of the fœtus in relation to that of the maternal pelvis, there is always a grave risk that the mother will sustain serious and possible fatal injury. Furthermore, even severe traction may fail. Thus it may be decided that embryotomy with the removal of the calf piecemeal is indicated. Such an operation is a long, difficult and exhausting one and it is possible that the obstetrician will decide even before attempting it, or during its course, that cæsarian hysterotomy is the only possible solution to the problem.

Here again, the operator should always consider the advisability of seeking the aid of a colleague.

THE EWE

In this species the facility with which malpresentations can be corrected will depend in large measure on the operator's ability to pass

or forced traction are to be employed, both narcosis and epidural anæsthesia should be induced. For the former, the author prefers chloral hydrate to the volatile narcotics. He administers it by intravenous injection in a dosage of 5-6 g. per cwt. in 10 per cent. solution in normal saline.

In all severe cases the operator should consider the advisability of seeking the assistance of a colleague, for it is always possible that the combined efforts of two will succeed where those of one alone fail.

THE COW

In the cow also delivery by the natural route is the foremost consideration. The delay before professional aid is sought varies greatly, and this is a factor which influences the course to be adopted. In protracted cases there is often severe impaction of parts of the fœtus in the pelvis; the greater part of the fœtal fluids has often been lost and there is insufficient space to repel the fœtus; the fœtal skin and the vaginal mucosa have lost their natural lubrication, while the vagina and vulva are often swollen and manipulation is rendered difficult thereby. When in such cases there is any departure from normal presentation, it is probable that the operator will proceed to embryotomy at once. If, however, presentation is normal and the case is one of relative oversize, controlled traction will be first attempted, but before doing so it is important that the vagina and those parts of the fœtus occupying it shall be lubricated as well as possible. For this purpose mucilage of linseed or acacia or one of the proprietary brands of obstetrical lubricant may be used. Failing these the copious application of soap and water is indicated. Traction, however, must be employed with consideration and discretion, for if it is impossible to extract the fœtus by this means its continued application makes for more severe impaction and this renders subsequent embryotomy very difficult or even impossible. In all cases such as these, anterior epidural anæsthesia should be induced at the outset. It may be found desirable to give a narcotic dose of chloral hydrate in addition—30-60 g. by the mouth. Under the influence of the anæsthetic it is generally possible to repel the fœtus sufficiently for the performance of intravaginal embryotomy. When applying epidural anæsthesia subsequent to handling a putrid fœtus, great care must be taken that infection is not introduced into the neural canal either through the medium of the needle or the anæsthetic solution.

More often, however, the case will be an early one; the calf is living and the uterus healthy. In the heifer it is often found that presentation

vened. It may be found in an hour or so that normal expulsion has recommenced or that on further examination more foetuses are accessible to manual extraction and by continued attention to the sow in this manner the whole litter can be removed. Quite often, however, complete inertia has developed and no further progress follows the removal of the accessible foetuses. In these, caesarian hysterotomy is the only means of saving the sow.

Cases will be encountered, however, in which, either as the result of natural smallness or of previous injury, the hand cannot be introduced into the uterus. In these, one's procedure will be influenced by the number of foetuses it is estimated are still unborn and also by the duration of the dystocia. If the case is recent and one or two foetuses only are thought to be present, delivery by forceps will probably be attempted. If, on the other hand, difficulty has occurred with one of the early foetuses and many more remain, or if inertia has supervened and the removal of the presented foetus will not significantly change the situation, immediate caesarian section is indicated.

THE BITCH

The primary consideration in the management of a case of dystocia in the bitch is—shall one proceed with delivery *per vaginam* or shall one immediately resort to laparotomy? Factors which will influence the decision are: (a) the cause of the dystocia, whether obstruction or primary inertia; (b) the duration of second stage labour and hence the condition of the foetuses and the uterine muscle; and (c) the number of foetuses involved.

When the case is recent, a matter of a few hours only, one will proceed to assist the bitch *per vaginam*. If the cause is relative oversize in anterior or posterior presentation it is probable that traction, using the finger and vectis or forceps, will succeed in effecting delivery and that from that point parturition will proceed normally. Similarly in cases of malpresentation such as vertex posture or breech, traction may succeed after correction of the posture. If, however, there is gross oversize of the foetus, and such should be suspected in litters of one or two only, early laparotomy is indicated.

In protracted cases of 24 hours' or more, laparotomy is the primary consideration, for it is probable that secondary inertia has supervened and removal of the obstructed foetus will not alter the ultimate outcome. In this connection, however, decision will be influenced by the number of foetuses involved. If one or two only, it is probable that attempts at

his hand through the pelvis into the uterus. In the majority of ewes this is possible, but occasionally, and especially in primigravid animals of the smaller breeds, it is impossible, and in these delivery *per vaginam* may fail.

In cases of relative oversize in normal presentation, the application of cords after retropulsion of the head or hips from the pelvic inlet is not difficult, and gentle traction effects delivery. Similarly in malpresentation of the limbs or head, reposition after retropulsion is, as a rule, relatively easy. In cases of lateral deviation of the head and breech presentation in which manipulative reposition fails, embryotomy using the guarded wire saw is indicated. Owing to the smallness of the lamb, the operation is easier than in the calf.

In the ewe it is especially important to ensure that the presented parts belong to a single fœtus. The young, in cases of twins and triplets are small and retropulsion and reposition is seldom difficult.

In ewes in which it is impossible to pass the hand into the uterus, delivery by forceps traction is indicated. The manner of application of the forceps is similar to that later to be described for the bitch. For the purpose forceps of the Hobday type, of appropriate size and fitted with a ratchet to maintain a secure hold when applied, are best. Snare forceps of the Roberts' type are also useful in head presentations.

Great care must be taken during intravaginal manipulations that the mucus membrane at the pelvic inlet is not lacerated. It is an accident which may occur quite simply, particularly when a finger is being used to lever a head or limb upwards. Such lacerations are usually followed by acute infection and death.

THE SOW

In the sow also, the ease with which obstructive dystocia can be relieved depends almost entirely on the operator's ability to pass his hand through the pelvic inlet. Provided this is possible it is usually a relatively easy matter to grip the head or hind parts and withdraw the fœtus. The disposition of the limbs is seldom of much consequence. When such assistance has been forthcoming early, i.e. within an hour or two of the onset of second stage labour, removal of a fœtus is often followed by the normal expulsion of the remainder. But assistance in the sow is frequently delayed, and in these cases the obstetrician will be well advised to remove as many piglets from the uterine body and cornua as are within reach. The subsequent course will depend chiefly on the measure of delay and thus the degree of inertia which has super-

CHAPTER 9

DELIVERY *PER VAGINAM* IN THE BITCH

BEFORE resorting to instrumental assistance the use of the finger should be fully exploited. When, for instance, parts of the fœtus have already passed through the pelvic inlet it is often possible by insinuating the finger over the occiput, into the intermaxillary space or in front of the fœtal pelvis, to apply sufficient traction to draw these parts into the vulva. Straining on the part of the bitch is of great assistance to one's efforts. Once parts of the fœtus are in the vulva, traction delivery is generally simple. In cases of posterior presentation in the ventral position this form of assistance is often effective also. In breech presentation it is generally possible to hook the fingers around the retained limbs and draw them upwards and backwards into the maternal pelvis. In vertex posture it is usually a relatively simple matter to insert the finger beneath the fœtal chin and by drawing it upwards direct the muzzle into the passage (Fig. 49). During all these manipulations it is helpful to fix the position of the fœtus in the uterus by gripping it with the left hand through the abdominal wall.

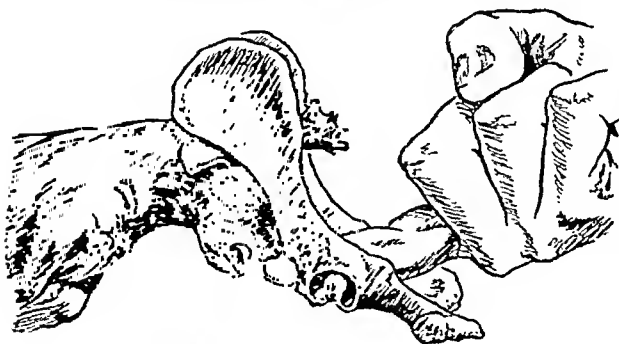


FIG. 49.—CORRECTION OF VERTEX POSTURE WITH THE FINGER.

forceps extraction will be made, but it must be pointed out that the application of forceps to dead and putrefying fetuses often results in their breaking up and removal necessitates prolonged "fishing" in the uterus to pick up the pieces, a difficult and dangerous procedure.

As a rule, narcotics will not be employed for the forceps delivery of a single fetus in a recent case, for it is important that nothing shall be done which tends to retard the subsequent course of parturition and also that the bitch shall be able to mother her puppies as they are born. When, however, prolonged forceps interference in a protracted case of dead fetuses is necessary, morphine narcosis or even light nembutal anaesthesia should be induced.

In protracted cases in which it is decided to perform laparotomy, the question arises—should one first attempt to remove the presented fetus *per vaginam*. It is probable that this fetus is grossly infected and interference with it through an abdominal wound will favour the development of peritonitis. There is also, of course, the possibility that forceps interference will subject the bitch to even graver risk. The author's attitude is that when the presented puppy is impacted in the pelvis, it is best to attempt its removal with forceps prior to commencing abdominal operation, but in all others he removes the presented fetus by laparotomy.

A further question which arises in laparotomy cases, and this has special reference to the anaesthetic to be employed is—how long after the onset of second stage labour is it likely that the puppies are alive? The author's experience has been that it is very improbable the presented fetus will live longer than 6-8 hours, for by that time its placenta will have completely separated. The remaining fetuses, however, may be alive for much longer periods; in fact, he has seen cases in which after 36 hours' delay the presented fetus was dead and emphysematous yet those occupying the anterior parts of the cornua were alive. He has never encountered living fetuses after a delay of 48 hours.

In all cases in which inertia has supervened, whether it be primary or secondary in nature, and three or more fetuses remain, laparotomy is indicated.

The respective indications for the two operations, hysterotomy and hysterectomy, will be discussed in a later chapter.

REFERENCE

Barcroft, J. (1941). *Nature*, July 26, 91.

CHAPTER 9

DELIVERY *PER VAGINAM* IN THE BITCH

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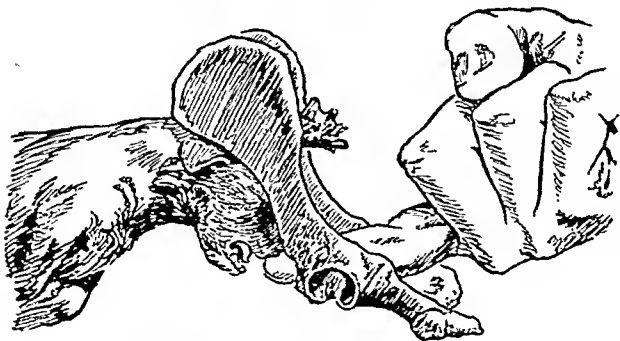


FIG. 49.—CORRECTION OF VERTEX POSTURE WITH THE FINGER.

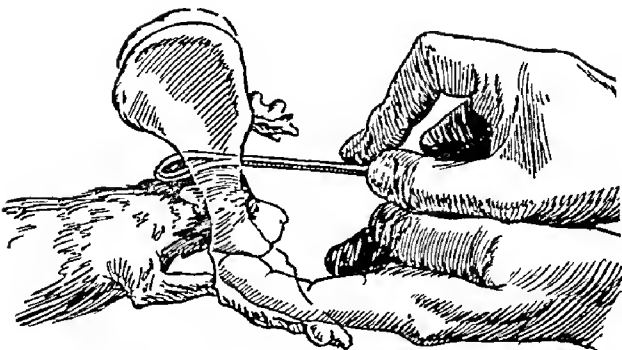


FIG. 50.—TRACTION APPLIED TO PUPPY'S HEAD USING THE VECTIS AND FINGER.

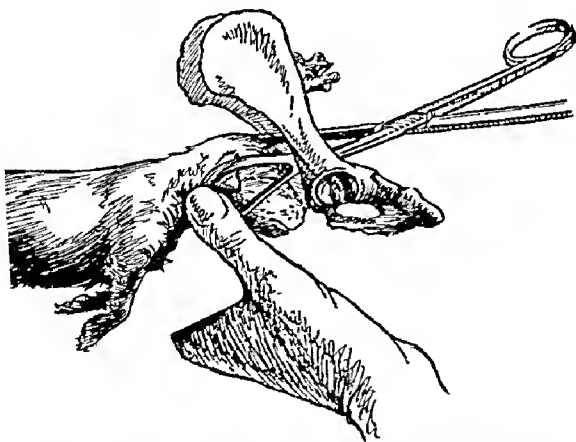


FIG. 51.—DELIVERY OF A PUPPY WITH RETENTION OF THE FORE LIMBS USING HOBDAY'S FORCEPS.

While fixing the position of the fetus through the abdominal wall with the left hand, the forceps are applied to the skull with the right.

When parts of the fœtus have already traversed the pelvic inlet and occupy the vagina, Hobday's vectis is a useful instrument. The vectis is passed into the vagina and, according to the presentation, over the dorsal aspect of the fœtal head or pelvis and by pressure downwards engaged behind the occiput or tuber coxæ. The index finger is then introduced and pressed upwards into the intermaxillary space or in front of the fœtal pelvis and between the opposing grips of the vectis above and the finger beneath it is often possible to apply sufficient traction to the fœtus to deliver it without injury (Fig. 50). The method may even be successful in cases in which the forelimbs are retained and the correction of which is difficult because of the presence of the head in the vagina.

In cases of relative oversize in anterior presentation in which the fœtus is entirely in the uterus and obstruction is caused by the size of the cranium, Roberts' snare forceps are of value, particularly in small bitches and cats. Such cases may also be associated with retention of the forelimbs. Should the latter be the case it is better to attempt delivery with the posture uncorrected, for they will cause no greater obstruction lying alongside the chest than they would if extended, for the subsequent traction applied as it is to the head only may cause the elbows alongside the head to become impacted at the pelvic inlet. Snare forceps are used as follows: while fixing the fœtus at the pelvic brim by holding it through the abdominal wall, the closed forceps carrying the snare are passed into the uterus and over the fœtal head until they lie above the neck. The jaws are then opened as widely as possible and depressed downwards until they lie ventral to the neck and then closed. In this way an encircling noose has been applied. By traction on the free ends of the snare the noose is drawn tight and it is held in position by the forceps. Traction is then applied to the forceps and the free ends of the snare (Fig. 52).

Freak (1948) recommends Rampley's sponge-holding forceps for the application of traction to the living fœtus in cases similar to those previously outlined. Using the index finger as a guide to their application, the forceps are lightly fixed to the upper or lower jaw, or even the whole snout. In the case of posterior presentation they may be applied to a hind limb until the fœtal pelvis is drawn into the maternal inlet and then a more secure hold obtained. Points made by Freak in favour of Rampley's forceps over those of the Hobday type, in relatively simple cases, are: first, they can be applied and fixed by means of the ratchet to comparatively small parts of the fœtus, and thus do not

increase the total size of the obstructing part when drawing it through the maternal inlet, and, second, that consequent on the lightness with which it is possible to apply them, the fœtus can be delivered uninjured.

Lateral deviation of the head and nape posture are abnormalities which require special consideration, for the diagnosis may be difficult and attempts to deliver fœtuses so presented without correction, even with severe forceps traction, are generally futile, at any rate in the healthy fœtus. In lateral deviation, the fore limb on the side opposite to the neck flexion has generally passed through the pelvic inlet (Fig. 46). Thus, the presence of a single forelimb in the anterior vagina indicates a likelihood of the condition. To verify the diagnosis and also to ascertain the side to which the head is deviated, the fœtus must first be repelled forwards. The finger is then directed laterally towards the iliac shaft in

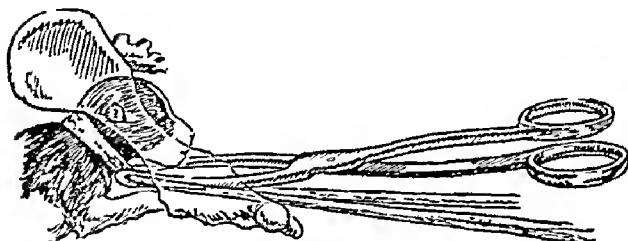


FIG. 52.—ROBERT'S SNARE FORCEPS APPLIED TO FœTAL NECK.

order to detect the fœtal occiput or ears. In the small bitch this may not be difficult, but in the large one the length of the maternal pelvis and of the fœtal neck are often such that it is impossible to make an accurate diagnosis, let alone correct the condition. In a protracted case it may be impossible to obtain the space in front of the pelvis necessary for exploration with the finger. The fœtal fluids have been lost and the uterus has contracted firmly on the fœtus, the latter often being enlarged by putrefactive emphysema.

Freak (1948) recommends Rampley's forceps both as an aid to diagnosis and to the correction of downward and lateral deviation of the head. It is proposed to quote her excellent description:

"The forceps are made of two long, thin blades, each with a circular handle at the end. The blades are curved to follow the contour of the fetal neck. They are used to grasp the fetal neck and pull it forward and laterally to correct the deviation of the head."

pelvic brim. To correct the posture a light grip should be taken on the skin over the occiput and the foetus slightly repelled. Forceps may be left *in situ*, supported by the finger and thumb, while an attempt is made with the other hand on the maternal abdominal wall to raise the foetal head above the pelvic brim. Sometimes the forceps grip and repulsion of the foetus are alone sufficient to bring this about, and the finger can then be inserted into the mouth to hold it in position while the forceps are reapplied on the upper jaw. Frequently correction has to be done in stages, obtaining a grip a little lower on the forehead after each repulsion.

Lateral deviation: Forceps are used to assist in the diagnosis of the posture and the side to which the head is deflected. The shoulder of the opposite side may be recognized by the finger or, again, the position of the ears may assist. When this is decided a grip is taken on that side of the head or neck presented and the foetus is repelled diagonally-away from the side to which the head is turned. Again the grip and repulsion may need to be repeated, and again, particularly in a small bitch, great assistance is derived from external manipulation assisted by guidance from the finger in the vagina.

Delivery by Forced Traction

This method is employed in cases of oversize when the less drastic methods previously outlined fail. It is used particularly in the case of dead and emphysematous foetuses. The method should, if possible, be avoided in the case of a living foetus, for the grip of the forceps generally causes it severe injury. Hobday's forceps are generally employed.

In cases requiring forced traction the whole of the foetus, with the possible exception of limbs, lies in the uterus. Occasionally, in cases of posterior presentation, the pelvis and hind limbs have passed into the pelvic inlet. In these it is best to repel these parts into the uterus before attempting to apply the forceps.

The aim is to obtain a secure grip across the foetal cranium or pelvis so that considerable traction can be applied. The application of the forceps to a limb or the lower or upper jaw is generally futile because the force it is necessary to apply causes either the forceps to slip or the parts to be torn away.

Operation should be carried out under ether or pentothal anaesthesia with the bitch in breast recumbency. The position of the presented foetus is fixed by gripping it through the abdominal wall. The closed forceps are introduced into the vulva and directed, at first upwards until they have reached the pelvic floor, then horizontally forwards through the pelvic canal and finally slightly downwards and forwards into the uterus. Here the foetal extremity will be felt beneath. The jaws of the forceps are now opened as widely as possible and again depressed downwards. On closing them it becomes clear from the extent to which

increase the total size of the obstructing part when drawing it through the maternal inlet, and, second, that consequent on the lightness with which it is possible to apply them, the fœtus can be delivered uninjured.

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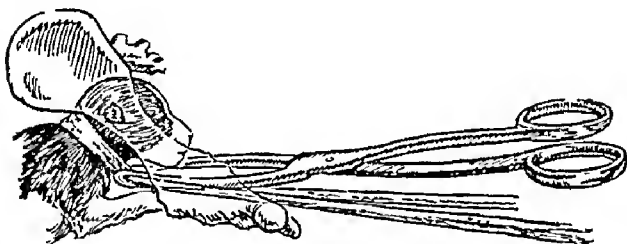


FIG. 52.—ROBERT'S SNARE FORCEPS APPLIED TO FETAL NECK.

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Breast-head posture: The forceps are of great assistance (to diagnosis), since a light grip may be obtained on one foreleg, if present, or on the neck, raising the fœtus sufficiently close into the pelvic inlet for a more complete examination to be made with the finger, when foetal ears may be recognized lying just below the

pelvic brim. To correct the posture a light grip should be taken on the skin over the occiput and the foetus slightly repelled. Forceps may be left *in situ*, supported by the finger and thumb, while an attempt is made with the other hand on the maternal abdominal wall to raise the foetal head above the pelvic brim. Sometimes the forceps grip and repulsion of the foetus are alone sufficient to bring this about, and the finger can then be inserted into the mouth to hold it in position while the forceps are reapplied on the upper jaw. Frequently correction has to be done in stages, obtaining a grip a little lower on the forehead after each repulsion.

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the handles are apart that the whole width of a foetal head or pelvis has been gripped. On no account should traction be applied until the operator is satisfied that he has a firm grip on the cranium or pelvis (Fig. 51).

Working in the dark as the method entails, the operator is always fearful lest he has picked up the uterine wall in addition to the foetus. Fortunately if the forceps are applied within the uterus in the method described there is little tendency to injury of the maternal soft parts in so doing, but nevertheless, as soon as the secured part has been drawn back to a point he can reach with his finger, the operator will ensure before proceeding that it is the foetus only which is involved.

Steady traction is applied in the upwards and backwards direction until the secured part has passed through the pelvic inlet. From this point delivery is relatively easy. It will be appreciated that there is a limit to the amount of force which can be safely applied, for severe pulling may cause rupture of the vagina at the pelvic brim. Such an accident necessitates immediate destruction of the bitch or laparotomy. The author has encountered a case in which such a rupture was followed by the progressive passage of the remaining foetuses through it into the abdominal cavity.

In protracted cases in which the foetuses are putrid the application of forced traction often results in breakage of the foetus, a head or hind parts are torn away. Often in posterior presentation, the foetal trunk is torn away and the head remains in the uterus.

Again in protracted cases in which complete inertia has supervened, attempts must not be made to extract foetuses from the cornua with the forceps, for it is highly probable that by so doing the uterus will be torn. Forceps delivery is only applicable to foetuses the extremity of which has passed into the uterine body.

It cannot be gainsaid, that grossly protracted cases should not occur. They are the outcome of ignorance or negligence. It is the duty of the veterinarian to educate the dog-breeding public in the normal course of parturition, to deplore delay and himself to carry out the appropriate interference at the proper time.

REFERENCE

Freak, M. J. (1948). *Vet. Rec.*, 60, 295.

PART II

(F. BENESCH)

CHAPTER 10

THE MECHANISM OF PARTURITION AND REPOSITION IN THE COW AND MARE

PARTURITION in all our domestic animals is fundamentally the same. It consists in an alternating play between the elastic fœtus and the maternal parts according to the principle of exerting the smallest force (according to the teaching of Gauss and Sellheim in man). The process takes place, very briefly, as follows: under the influence of the driving, bending, and rotating forces of the elastic genital passage the labour pains are extended to the whole body of the fœtus—the elastic object of parturition. We have, therefore, in parturition to deal with an elastic process of movement involving the whole body of the fœtus and the whole of the genital passage at once, and not merely with a simple local process of adjustment between the fœtus and the maternal pelvis. The uterine contents are uniformly “forced” into the world actually by the simplest methods, and by a relatively straight path, in the direction of the constantly decreasing resistance, and thus by means of a definite presentation, position and posture the best adaptation of the fœtal body to the maternal outlet is established.*

The genital passage adapts itself to the fœtus and the fœtus to the genital passage. The bulk of the young one, however, provokes expansion of the posterior part of the maternal passage, but the possibility of this expansion is subject to great variations, according to breed, size and age. These variations depend upon differences in the individual conditions, both with regard to the size, form and plasticity of the soft parts and bones of the genital passage; and the size, flexibility and adjustment of the fœtus. Consequently no two parturitions are exactly the same. Obstetrical practice in the larger domestic animals must be based, as is normal delivery, on the principle of exerting the least possible force.

* The active participation of the fœtus plays an important rôle in parturition, but this will not be considered further here.

Its chief objects are as follows:

1. To give assistance, in cases in which the natural forces of expulsion are weakened, by additional force—i.e. manual extraction. This, however, must always be exerted with the strictest regard to the fact that parturition deals with an elastic process and not a rigidly mechanical body. Strengthening of the power of expulsion by the administration of ecbolics, as in small mammals, is never required intrapartum in the cow or mare.

2. Avoid excessive force in correction of the presentation, position, or posture of the fœtus by obtaining more space, by episiotomy or by reducing the size of the fœtus.

3. To avoid entirely the use of force as an aid to natural labour by delivering the fœtus through another exit—i.e. cæsarian section. In this connection it must be emphasized that in the cow and mare, in borderline cases embryotomy, which has now reached a high degree of perfection, is preferable to cæsarian section from the viewpoint of safety to the mother.

The application of the measures mentioned in point 1 necessitates a precise knowledge of all the mechanical aids and hindrances to the fœtus during its passage, as delivery, whether it results from the normal forces (uterine contraction and abdominal compression) or from manual traction, depends upon (a) the forward movement of the fœtus in the direction of the long axis of the genital passage (the line of direction according to Sellheim's definition for the human fœtus); (b) the rotation of the body of the fœtus on its longitudinal axis from the lower to the upper position; and (c) deformation, which completes the adaptation of the fœtal body to the outlet under the reciprocal forces exerted by the mother and fœtus.

To comply with the conditions mentioned under point 2, and especially with the object of avoiding excessive force in correcting the presentation, position and posture of the fœtus, the general laws governing an effective mechanical process must be observed. These may be described as follows:

In most textbooks on obstetrics the principle that the exertion of several forces is necessary for the reposition of displaced parts and for the correction of faulty positions of the fœtus is not clearly explained. The method is indeed frequently employed, but the great importance of the simultaneous application of two, but antagonistic, forces, upon the body of the fœtus or parts thereof is either not mentioned at all or insufficiently emphasized and treated as a matter of secondary significance. On the other hand, in some textbooks retropulsion of the

fœtus together with manipulation of the head or limbs with the object of guiding them into the pelvic cavity is regarded as the most important aid to parturition. From the mechanical standpoint such descriptions must be regarded as incomplete, and to some extent even incorrect, as the following explanation will demonstrate:

Granted that the necessary space is available for correction and that it can be maintained for a sufficient length of time (in this connection the position of the mother is of great importance), the procedure of reposition, which is usually performed with one hand only, is often difficult, especially in the case of a large fœtus in a young and heavy mother or when the operator possesses only moderate strength. The hand must frequently be used for elevating, turning, and exerting traction, and at the same time counteract straining in addition.

The above presupposition, however (provision of favourable conditions of space), is often absent or only partial. Retropulsion of the fœtus, even to a small extent, often presents considerable difficulty (prolonged fœtal impaction, deficient amniotic fluid, etc.). Moreover, retropulsion of the fœtus, by stretching the uterine wall, provokes abdominal contractions, apart from normal straining, and thus the space which has with difficulty been obtained is almost immediately lost before there is time to utilize it. Under such conditions great demands are made upon the strength of the operator, quite apart from other disadvantages, such as increasing dryness and swelling of the soft parts of the genital passage, which must not be underrated. It is therefore important for the obstetrician to reserve his strength and not waste it on less promising procedures, as otherwise he may be unable subsequently to cope with operations of decisive importance.

As all corrections of posture and position of the fœtus or parts of it comprise, fundamentally, rotation in one geometrical plane, and as these corrections can be easily carried out by the compensatory result of two simple forces, the principle of compensatory forces becomes the beginning and end of the mechanics of reposition.

The gravid uterus represents an elastic sac, becoming narrowed at its cervical opening in the pelvis, which, owing to the horizontal course of the maternal vertebral column, presents a more or less marked ventroversion over the border of the os pubis. As long as the rotation of the body and extension of the head and limbs necessary for normal delivery can take place in the largest diameter of the uterus, the presentation of the fœtus surrounded by a sufficient quantity of amniotic fluid usually proceeds smoothly.

It is easily understood that in normal delivery a uterus partly filled with amniotic fluid presents much more favourable conditions for the process of parturition than one from which this fluid has been entirely evacuated, and which therefore clings closely to the fœtus with its complicated surface. Apart from the differences in the action of the inner surface of the uterus on the outer surface of the fœtus in the two cases mentioned, the importance of the fluid interposed between the uterine wall and the fœtus in normal parturition is explained as follows: The direct pressure exerted by the contracting uterus, augmented by that of the abdominal muscles, extends through the amniotic fluid and the mouldable body of the fœtus to the conical amniotic sac entering the internal os of the cervix. The amniotic fluid therefore serves as the means of transmitting the pressure to the dilating cervix. As long as the fœtal membranes remain intact this pressure is through the medium of the amniotic fluid alone, and is thus a hydraulic one.

All factors, whether internal or external, which give rise to dystocia unfavourably alter the situation in a two-fold manner:

1. The gliding capacity of the outer surface of the fœtus necessary for normal parturition is lost, because the amniotic fluid has, as a rule, escaped previously.

2. In a short time there is no space for rotation or extension, because (a) the elastic wall of the uterus, deprived of its hydraulic resistance, soon comes in intimate contact with the body of the fœtus; and (b) the necessary rotation and extension of the fœtus are prevented consequent upon its becoming impacted at the pelvic inlet. The bony pelvic inlet forms an insuperable obstacle to the normal extension of the fœtus, and as the uterus has become constricted both in its transverse and longitudinal extent, the fœtus is directly arrested at the pelvic inlet.

To overcome this the obstetrician must proceed cautiously in undertaking any operative interference, for the following reasons:

1. He must aim not only at relieving the tension of the uterine muscle, but also at reducing the abdominal pressure (straining) in order to obtain the necessary conditions for correction (mobility and gliding capacity).

2. The correction of faulty presentation, position or posture by the application of mechanical force must never be carried out roughly. The least force possible should be applied and all risk of danger to the mother avoided. At the same time it must be capable of application under conditions which are most unfavourable for manipulation, such as lack of space and distance from the vulva.

These conditions may be complied with in several ways:

1. By the free use of extradural (epidural) anæsthesia or general narcosis (chloral hydrate) (see next chapter).

2. By the application not of a single force but of several forces. By this means pressure is exerted at one end of the part to be rotated while traction is made simultaneously or shortly afterwards at the other end, in the opposite direction. By pressure must be understood the force exerted by the operator to repel the fœtus within the uterus, while traction signifies the force exerted from the uterus outwards, whether these forces act in the direction of the longitudinal axis of the mother animal or obliquely on the body parts of the fœtus.

This form of mechanical reposition possesses several advantages:

(a) Through the pressure force not only is the part to which it is applied expelled from the pelvis, but also, according to circumstances, the whole body of the fœtus.

(b) The action radius for rotation undergoes suitable local displacement and also a maximal shortening, so that the procedure of reposition can always be applied at the level of the pelvic inlet (not below it), and thus be limited to the smallest possible space.

(c) The amount of muscular effort required for reposition, when there is a two-fold division of force, is much less than when one force only is used.

3. By the adoption of a useful and simple instrument instead of the hand to exert the forces necessary for reposition. The instrument, whilst of simple construction, should be such that it serves several purposes, and should be capable of secure fixation to those parts of the fœtus to which it is applied, even to pointed parts such as the hocks.

4. The conditions necessary to effect reposition of the displaced parts, in accordance with the laws of mechanics, can be fulfilled even when the operator's arm is insufficiently long for manipulation or lack of space hinders its movement by the use of a specially designed, long-handled blunt crutch, the end of which is adapted to take a cord by means of which it may be effectively fixed to the fœtus (see Fig. 61).

When the operation can be performed with an instrument which complies with the conditions mentioned in points 2 and 3, such an instrument fulfils in a high degree the objects of obstetrics.

5. Lastly, the requirements of special cases, such as ventral transverse presentations, in which it is necessary to apply pressure in the depths of the uterus beyond the reach of the arm, can be safely performed with the same instrument by simple methods which will be described.

CHAPTER 11

EPIDURAL ANÆSTHESIA AS AN AID TO OBSTETRICAL PRACTICE IN THE COW AND MARE

It is well known that every intra-uterine obstetrical operation gives rise to more or less marked straining. Its force varies according to the duration of the case and the degree of impaction of the fœtus in the pelvis. In addition, the contents of the uterus are continually being diminished by the escape of the amniotic fluid, until eventually the sac encloses the fœtus in the manner of a tense, hollow muscle. Again, in a prolonged case of parturition congestion causes marked swelling of the genital passage.

In changing the position of the fœtal parts within the uterus, therefore, two forces have to be counteracted: the first, the action of abdominal pressure; and the second, the tension of the uterus, which is in close contact with the body of the fœtus.

Often these obstacles can be overcome by the force of the arm alone, especially with the assistance afforded by raising the pelvis and the introduction of a substitute for the amniotic fluid. At the same time, in many cases the difficulties associated with reposition are very considerable. Even slight movements of the arm lying in the genital passage may give rise to powerful straining, especially if the vaginal or uterine wall is much distended by the displacement of flexed joints or entire parts of the fœtus. The whole or greater part of the fluid introduced as a substitute for the lost liquor amnii is prematurely expelled, even if this has not already occurred during injection as the result of straining, and eventually the possibility of obtaining the necessary space for reaching the fœtal parts becomes continually less the longer the attempts at reposition are continued.

By the use of epidural anæsthesia abdominal counter-pressure becomes removed, and thus space is procured for manipulation and the amount of force required is reduced. It can be employed by the obstetrician working without assistance under farm conditions.

Its advantages in obstetrical practice in the cow and mare are manifold:

1. The pain accompanying operative interference is either entirely abolished or greatly reduced, an effect which is of great importance from the humane standpoint.

2. The linseed infusion introduced as a substitute for the liquor amnii is not, as otherwise often happens, immediately ejected, but becomes distributed slowly and evenly between the fœtus and the uterine wall, thus causing a considerable loosening between the mucosa and the surface of the fœtus. This results in the restoration of the mobility of the fœtus within the uterus.

3. A natural result of the relaxation of the uterine wall consequent upon the absence of abdominal pressure is that the space required for the reduction of displaced fœtal parts or for rotation of the fœtus on its longitudinal or transverse axis is produced, and reposition can be effected without resistance on the part of the mother. The degree of relaxation corresponds with the degree of anæsthesia present.

4. As defæcation is suspended for the duration of anæsthesia, the operation is clean and asepsis is more easily maintained.

5. Its application when properly performed is, in the author's opinion, entirely free from danger.

6. Normal involution of the uterus is not interfered with.

The introduction of epidural anæsthesia, however, does not imply that it should be employed as a routine in every case. It is not necessary in those in which internal examination indicates the probability of a rapid and smooth course of delivery.

Method of Procedure

THE COW

Anæsthesia may be induced either in the standing or the recumbent position. In the former case, in order to prevent the animal falling, a small quantity (10 to 20 c.c. per 300-600 kg. body weight (6-12 cwt.)) of a sterile 1 per cent. solution of tutocain* (novocain) at body tempera-

* Considerable confusion occurs as to the nature of the numerous synthetic local anæsthetic agents used for epidural anæsthesia, marketed under proprietary trade names.

Procaine hydrochloride of the British and U.S. Pharmacopœias is the hydrochloride of diethyl-aminoethyl-*p*-aminobenzoate. It is the agent which is marketed under

caine,
5 per cent.

Tutocaine composition.

Tutocain: the hydrochloride of *p*-aminobenzoyl-dimethyl-aminomethyl butanol.

Pantocaine: the hydrochloride of *p*-butyl-aminobenzoyl-dimethyl-aminomethyl butanol. English and American obstetricians generally employ concentrations of 2-3 per cent., occasionally 5 per cent., in doses similar to those specified by the author.

Percaïne (nupercaine) is of different chemical composition, being a cinchoninic acid derivative. It is employed in concentrations of 0.1 per cent. (J.G.W.)

ture is injected. If pronounced motor paralysis of the hind quarters supervenes, the animal must be supported by assistants on either side of the pelvis while the operation of reposition is being carried out, or the operator may wait until she lies down. In the recumbent position 30–50 c.c. of the same solution can be injected without fear. The anesthesia develops in about 5–10 minutes after the injection, and lasts for $1\frac{1}{2}$ hours.

Technique. The point of puncture is the depression between the first and second caudal vertebræ. This can be located with the finger by



FIG. 53.—EPIDURAL ANESTHESIA IN THE COW.
Site of puncture shown by the needle.

moving the root of the tail in the sagittal plane. After clipping, shaving, and disinfecting the skin, the puncture is made perpendicularly to the dorsal line of the sacrum (Figs. 53, 54 and 56) with a strong hypodermic needle, 6–8 cm. ($2\frac{1}{2}$ –3 inches) long, inserted in the centre of the intervertebral depression as far as the vertebral canal (2–4 cm. ($\frac{3}{4}$ – $1\frac{1}{2}$ inches) deep). To determine that the end of the needle is in the canal, a little of the fluid should be injected; if it flows easily under slight pressure, the position of the needle is correct, but if force is necessary the canal has not been entered and the needle must be withdrawn and its site of

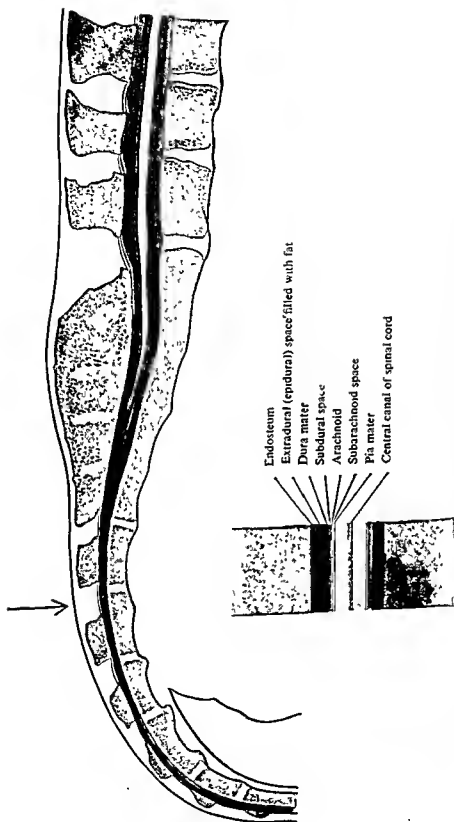


FIG. 54.—DIAGRAM TO DEMONSTRATE THE SPINAL MENINGES AND THE DISTRIBUTION OF THE SPACES IN THE VERTEBRAL CANAL OF THE COW (REGION OF THE OS SACRUM).

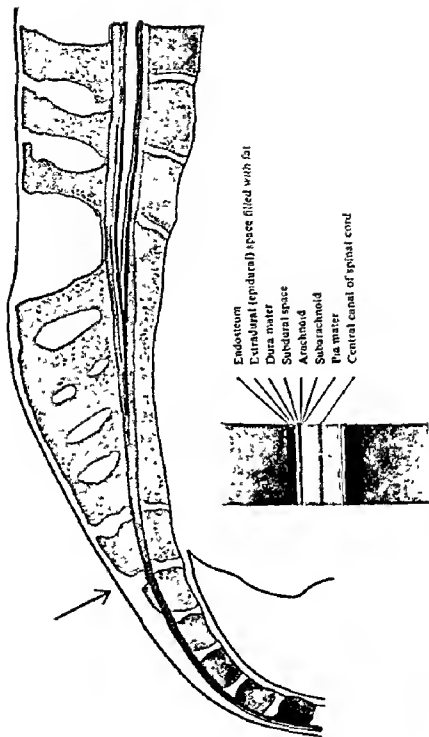


FIG. 55.—DIAGRAM TO DEMONSTRATE THE SPINAL MENINGES AND THE DISTRIBUTION OF THE SPACES IN THE VERTEBRAL CANAL OF THE MARE (REGION OF THE OS SACRUM).

direction altered. If the puncture is made too deeply—i.e. through the epidural space into the intervertebral cartilage (Fig. 56)—slight withdrawal of the needle is generally sufficient. The anæsthetic fluid should be injected slowly and with short pauses in the standing animal, in order to avoid motor paralysis. In puncture of the epidural space the spinal fluid, naturally,* does not flow from the end of the needle, but sometimes, if a vessel has been accidentally punctured, blood escapes. In this

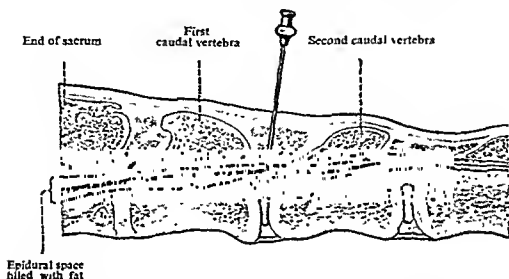


FIG. 56.—LONGITUDINAL SECTION THROUGH THE CAUDAL VERTEBRÆ OF A COW.

event the anæsthetic solution can still be injected without harm, or if necessary the needle can be withdrawn, cleansed of clot and reinserted.

THE MARE

For anatomical reasons epidural injection in the mare is usually more difficult than in the cow, especially when the croup and root of the tail are well covered by muscle or fat. With experience, however, these present no difficulty. The articulation between the first and second caudal bones can readily be felt with the finger, when the tail is moved in the dorso-ventral direction, even in the coarse breeds. Whilst the direction of the needle is at an oblique angle to the general line of the animal's back, it is approximately at right angles to the inclination of the sacrum (Figs. 55 and 57). Penetration must be somewhat deeper than in the cow (4–8 cm. (1½–3 inches)), as the vertebral bodies in this situation are larger in equines, and the outer covering (skin, muscles and liga-

* The cerebro-spinal fluid occupies the subarachnoid space, whereas in epidural anæsthesia the injection is made outside the dura mater beyond the termination of the spinal cord.

ments) of the root of the tail is thicker. It is therefore advisable to use a longer and stouter needle (8-10 cm. (3-4 inches) long and about the thickness of a knitting needle).

The dose in the standing position for light mares should be 15-20 c.c., and for heavy mares 20-30 c.c. of a 1 per cent. tutocain solution. For delivery in the recumbent position 60 c.c. or more can safely be given.

Technique. This is the same as in the cow, except that the needle must penetrate more deeply to enter the epidural space. Special care is necessary regarding the dosage and the concentration of the anæsthetic



FIG. 57.—EPIDURAL ANÆSTHESIA IN THE MARE.
Site of puncture shown by needle.

solution employed; and the injection must be made very slowly, especially when anæsthesia is induced in the standing position. An excess may cause severe motor interference of the hind limbs, resulting in an alternating flexing and extending of the hock and fetlock joints for several minutes, after which the animal may go down. This accident must be prevented in good time, as (1) the impression produced on an independent observer that the animal can only maintain the erect posture by great exertion of its hind quarters is alarming, (2) a sudden fall may sometimes cause fracture of the pelvis or fetlock, sprains, etc. The aid of several assistants to support the animal during anæsthesia is therefore

necessary, or some other measure of support (such as slings, or supporting against a wall) available. As in large animals a slight degree of anæsthesia is a very great aid to correction of presentation, and as it is generally preferable to work in the standing position, both with the mare and the cow, it is better to give a small quantity of the anæsthetic solution than a large one, and if necessary repeat the injection or increase the concentration to 2 or 3 per cent.

CHAPTER 12

OBSTETRICAL EQUIPMENT

WHILST this should be as simple in design as possible, it must be capable of dealing with all the abnormal conditions likely to be encountered in practice. Instruments should be chosen which can be used, even by the less experienced, without danger of injury to the mother, and when possible should be adaptable to several purposes. Elaborate instruments and embryotomes whose uses are restricted to exceptional cases constitute a great financial burden to the practitioner. In this connection we have to consider:

1. A series of snares, consisting of three plaited hemp cords (foot snares) 1·8–2 metres (5–6 feet) long and about 1·5 cm. ($\frac{3}{4}$ inch) broad



FIG. 58.—FOOT SNARE WITH TRACTION BAR.

(Fig. 58). The inclusion of a "head snare" is, in the author's opinion, superfluous, and even dangerous. Apart from the difficulty of applying it to a displaced head, it offers no mechanically effective possibility of fixation in such cases, because it always slips to the curvature of the neck. If the head lies with the face directed towards the pelvic outlet, forcible traction or a snare around the nape of the neck usually injures the vertebral column, causing laceration and even hæmorrhage into the spinal cord, with death of the *fœtus*.^{*} A snare around the jaw, on the one hand, and eye hooks on the other, form, as will be shown later, a much more efficient method of rectifying a displaced head, and for the application of considerable force during extraction. Rope snares

^{*} English readers may disagree with this contention. If the head snare is applied to the occiput immediately behind the ears and drawn tense with the loop situated in the fetal mouth, the point of traction is the occipital bone and not the occipito-atlantal space.

(as used by laymen) are not suitable for veterinary purposes, as they are stiff, apt to cut, and cause too much friction resistance. As a general rule, only snares which have been boiled and kept in liquid paraffin should be used. Small traction bars are an advantage. Snares prepared by the owner should not be employed.

2. (a) Schricver's Snare Introducer. On account of its weight, this is most useful for the introduction of snares in the vertical plane, but is somewhat awkward on account of its size. It consists of an elongated



FIG. 59.—SCHRIEVER'S SNARE INTRODUCER.

oval zinc plate with two large perforations, one for attachment to the snare and the other for the finger of the operator (Fig. 59).

(b) Lindhorst's ring introducer for the introduction of snares in the transverse plane (Fig. 60).



FIG. 60.—LINDHORST'S RING INTRODUCER.

3. A pair of blunt eye hooks (Freiberger's model) for the living foetus (Fig. 65) and a pair of sharp hooks (Harm's model) for the dead foetus (Figs. 84 and 85). These may be applied singly, but are generally inserted in pairs, one in the medial canthus of each eye. They are connected by a snare and so fixed that traction can be applied without danger to the mother or foetus. It is only in emergency cases that single hooks are used, and then a sharp one is preferable, even when the foetus is living. It is easier to apply and remains more firmly fixed, whereas a blunt one may easily slip from the orbit.

4. Kühn's Crutch (Fig. 61). This instrument was introduced by Dr. Kühn (Dürnkut), who recommended it solely for the correction of the flexed position of the hock joints in calves and foals (verbal communication). For a number of years the author has been using the instrument not only for that particular abnormality but also for the correction of other displacements, where it is an indispensable aid. Experience has proved, however, that a crutch with an unjointed shaft is preferable, especially for reaching displaced parts of the well forward in the uterus. The modification of this instrument, in which the two parts are

joined by a bayonet lock ensures that no loosening or unscrewing of the joint can occur when the instrument is being used for the ordinary requirements of reposition. When, however, extra force is used, such as is required for leverage, the joint has proved insufficiently strong and bending occurs.

The instrument is a long-handled fork 84 cm. (2 feet 9 inches) long, with a ring at the end of each branch of the fork through which is passed the snare for fixing the crutch to that part of the body to be corrected.

Its special advantage is the security of its fixation to the part of the body which is chosen as the point of attack for pressure and traction. With it the obstetrician is enabled to effect reposition within the uterus according to the laws of the simultaneous application of two opposing forces. A further advantage is that, consequent upon its secure fixation, great force can with safety be applied for the retropulsion of parts or even the whole of the fœtus. Again, pressure can be applied, or a snare attached, to those parts in the depth of the uterus beyond the reach of the arm.

Becker's club crutch, on account of the spherical design of its head and the ease with which it can be fixed to a part, is also a useful instrument, but it does not replace Kühn's crutch.

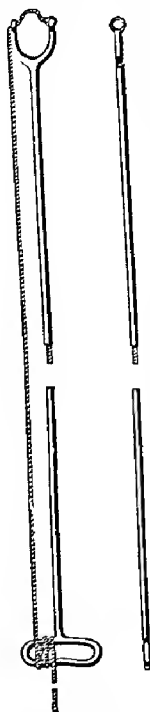
5. An anal hook. Obermayer's hook, on account of the curvature of its shaft and the relatively small hook, is most useful (Fig. 62).

6. Cämmerer's Torsion Fork. This was devised by Cämmerer for the reduction of torsion of the uterus in those cases in which either the fore or the hind limbs of the fœtus can be drawn into the vagina. For the obstetric specialist it is usually an indispensable instrument, but in the author's experience it is also suitable for rotation of the fœtus

FIG. 61.—KÜHN'S CRUTCH.

An instrument without the screw joint is preferable.

on its longitudinal axis from the lower to the upper position (Fig. 63), especially in protracted cases. For fixation of the instrument, the



following are required: two foot-cuffs of stout sailcloth, and two strong snares to fix securely the limb to the shaft of the fork. The tension on



FIG. 62.—OBERMAYER'S HOOK (TO BE USED AS AN ANAL HOOK).

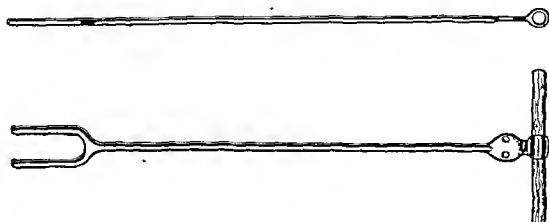


FIG. 63.—CÄMMERER'S TORSION FORK.

the limbs fixed to the rotation rod can, however, be equally well effected by the ordinary traction cords (Figs. 131, 132). (Foot required when using Kühn's crutch for rotation of the fo

CHAPTER 13

SHORT RULES FOR THE HANDLING OF OBSTETRICAL CASES

General Principles

1. MODERN surgical practice in obstetrics, in contrast to lay interference, is based on two firmly established principles:

The first, *asepsis* and *antisepsis*.

It is essential that only instruments whose plating is of good quality and snares which have been sterilized by boiling shall be used.

There should be available facilities for the operator to wash both himself and the external part of the patient, together with receptacles to hold warm antiseptic solutions for the operator's arms and instruments.

After thorough cleansing of the vulva and its surrounding parts with soap and warm water, by an assistant, a clean bed must be made with straw and planks, upon which is laid a tentorium, sheet, or linen cloth.

Using strict antiseptic precautions, instruments and traction snares should be laid on a table covered by a clean towel, and replaced there after use. It is contradictory to the principles of obstetrics for instruments and snares to be taken directly from an instrument bag, or from the floor of the stall or a milking stool, with wet or bloody hands.

The second principle is that by careful enquiry into the history, together with a careful examination of the patient, the exact state of affairs can be determined in every case; and the most favourable interference both as regards the welfare of the mother and the fœtus can be considered.

Anyone who conducts a case of parturition without regard to asepsis and without a careful consideration of its requirements, who infringes the fundamental principles of surgery, which by their very nature cannot be the subject of variable opinion, is guilty of malpractice, and is, at least, morally culpable.

Decision as to the technique to be adopted in effecting delivery should be based upon a definite plan in accordance with the following scheme:

(a) Correction of malposition (reposition). Is this indicated and is it feasible?

(b) Extraction by force in faulty positions. Is this likely to be successful—e.g. in deep impaction of the breech in the pelvis? Is it contra-indicated—e.g. in head-breast presentation?

(c) Is it possible, by replacement into the uterus of those parts of the foetus already in the vagina, to facilitate the correction of the whole?

(d) Is embryotomy indicated, and, if so, which method should be adopted?

(e) Is immediate destruction of the animal indicated consequent upon rupture, marked swelling of the genital passage, emphysema of the foetus, marked disturbance of general health, etc.?

2. In all obstetric operations suitable clothing must be worn. It may, however, be left to individual choice whether an obstetric overall, or apron of rubber or American cloth, or an armless flannel shirt is used; or whether the operator wears only washable linen trousers and apron, with the upper part of his body bare. In warm stalls operating with the upper part of the body exposed is certainly preferable to a sweat-soaked shirt.

3. Reposition is generally easier to effect with the animal standing than when recumbent. In the latter position, especially in mares, œdematous swelling of the vagina rapidly occurs, and thus the owner should be instructed to keep the mare up by walking it around, if possible, until the arrival of the veterinarian. For delivery, however, especially when strong traction has to be exerted, the best conditions, both anatomically and mechanically, are fulfilled by the recumbent position (Drahn, *Berlin. tierärztliche Wochenschrift*, 1924). If delivery is to be effected in this position, arrangements should be made, prior to examination, for raising the hind quarters and for allowing for sufficient freedom of movement by the removal of other animals nearby. Elevation of the hind parts may be effected in several ways:

(a) By the use of firmly bound bundles of straw. A disadvantage of this method is that after a time the animal sinks into the straw or slips to one side or forwards, and thus in prolonged cases the straw has frequently to be replaced.

(b) By the use of an improvised inclined plane. A thick board or a strong door is pushed sideways under the cow's hind quarters, while the other side is raised for 20 to 30 cm. (about 8 to 14 inches) and supported on pieces of wood. A rope is then passed round the animal's breast in the form of a harness and attached to the rear end of the board, to prevent slipping forwards.

(c) By rolling the cow on its belly and raising the hind quarters by two ropes passed under the groins. This can be done by a pulley or by the insertion of a strong crossbar attached to the ropes tied above the sacrum. The crossbar acts as a lever and raises the position on one side.

Lastly, by the use of epidural anaesthesia extensive raising of the hind quarters can be dispensed with, there being no interference with the operation from straining. It is sufficient to place enough straw under the animal to render the genital passage easily accessible.

Whenever the animal is being raised, care must be taken to avoid excessive force on the tail, as fracture of the vertebrae may result.

For the operation of reposition in the recumbent attitude the animal should be so placed that the part of the foetal body to be corrected is directed towards the free, upper abdominal wall and not downwards, otherwise the mother lies directly upon the displaced part.

4. Care should be taken to ensure that there is sufficient illumination and that extra assistance is available if required.

5. The greatest solicitude for the suffering of the animal should be coupled with a firm determination and a calm but energetic attitude towards the owner and onlookers. Without self-reliance and without the power of inspiring confidence effective veterinary work is inconceivable.

Special Principles

After a general enquiry into the duration of gestation, the time of rupture of the foetal membranes, the onset of forceful labour and as to any lay assistance that has been attempted, and after examining the animal's pulse, respiration and temperature, an internal examination is performed for the purpose of determining the following:

1. The condition of the genital passage, with special regard to linear or circular constriction of the cervix uteri, dilatation or constriction of the vagina, and the state of the pelvis—e.g. normal, infantile or constricted by callus.

2. The presentation, position and posture of the foetus (see following section). For determining these, especially when limbs only, without the head, are felt, a careful examination as to whether they are fore or hind limbs is essential. By palpation of the digits and by counting and flexing the joints beyond them, this can be determined. Thus in the hind limb there is only one important joint (the fetlock) between the digit and the hock joint, whereas in the fore limb there are two joints between it and the elbow (the fetlock and carpus).

3. Whether the fœtus is living or dead. The presence of a living fœtus is indicated by the reflex movements in the natural orifices, such as the tongue reflex after seizing it, the movements of the jaw, the eyelid reflex, sphincter contraction; and also by pulsation in the umbilical arteries. Signs of death are absence of reflexes, absence of pulsation in the umbilical cord, an abundant discharge of meconium about the anus, and finally cutaneous emphysema.

4. The presence of a rupture of parts of the vaginal wall or uterus (lay treatment).

5. The condition of the mucosa of the genital passage—i.e. slippery, dry or œdematous. The condition of the skin of the fœtus—slippery or dry, emphysematous, loss of hair. In putrefactive emphysema special care must be taken by the obstetrician against self-infection. Repeated disinfection of the arm with hot perchloride of mercury solution during operation and rubbing with a consistent fat such as lanoline, vaseline, etc., after drying, are absolutely necessary to prevent it.

6. Strength of the labour pains. By the state of affairs found on examination (fresh or protracted case) it can be decided whether manual reposition or operative interference without epidural anæsthesia should be attempted; or whether the case should be dealt with from the outset under regional anæsthesia. In the latter case strict aseptic and antiseptic precautions must be taken, especially when the hand has previously been in contact with a putrid fœtus.

7. After the complete history has been obtained and a careful examination made, the obstetrician, before commencing operation, must decide, if possible, whether it is probable that he will be able to effect delivery alone or whether it would be better to consult a colleague. Nothing injures the reputation of an obstetrician more than an operation begun with confidence but left unfinished.

CHAPTER 14

DEFINITION AND CAUSES OF DYSTOCIA

IN order to understand properly the difficulties of parturition, it is necessary to define presentation, position and posture. *Presentation* signifies the relation of the longitudinal axis of the fœtus to that of the mother. It includes the longitudinal disposition of the fœtus, with either its anterior or posterior extremity adjacent to the pelvis (anterior and posterior presentation), transverse (transverse abdominal and transverse dorsal), and vertical dispositions (abdominal and dorsal).

The term *position* signifies to which surface of the uterus the fœtal vertebral column is applied. It includes a dorsal, ventral and right or left lateral position.

By *posture* is understood the disposition of the individual movable parts of the fœtus, such as the head and limbs, in relation to the body. It includes a lateral posture of the head, a flexed posture of the shoulder, a flexed posture of the hock joint, etc.

Dystocia, in the cow at any rate, may be due to overdevelopment of the fœtus, the maternal pelvis being normal (absolutely too large fœtus), or to an abnormally small size of the maternal pelvis (juvenile pelvis, diminution of the pelvic cavity by callus formation after fracture, etc.) with a fœtus of normal size (relatively too large fœtus).

The causes of some cases, in which the fœtus and the genital passage appear normal, remain altogether unknown. Some of these are included in the term "internal causes," the nature of which cannot always be explained. Among them should be mentioned spontaneous premature rupture of the fœtal membranes, due either to excessive force of uterine contractions or to abnormally thin membranes; also torsion of the uterus and intra-uterine death of the fœtus.

A special group of internal causes comprises developmental malformations of the fœtus—single and double monsters. The nature of these can, in most cases, be recognized on examination, examples being hydrops of the fœtus, chondrodystrophia, schistosoma reflexum, ankylosis of joints, etc. Not infrequently, however, the malformation is associated with that extremity of the fœtus distant from the pelvis, and it is not discovered until assisted delivery or even embryotomy is in

progress, an example being hydrocephalus in breech presentation. Most cases of dystocia are due to "external causes." These include insufficient dilatation of the soft parts of the genital passage, which results in faulty presentation, position, or posture. The principal causes are premature rupture of the foetal membranes and premature attempts at extraction by lay persons before the foetus has completely rotated and extended; but to these must be added unscientific efforts at reposition, especially unsystematic attempts to deliver without suitable instruments.

CHAPTER 15

DELIVERY OF ABSOLUTELY AND RELATIVELY LARGE FŒTUS IN ANTERIOR AND POSTERIOR PRESENTATIONS

THE COW

A. Anterior Presentation

By Increased Traction. Examination reveals that the fœtus is presented normally in the dorso-sacral position with the extended head lying on the fore limbs. Provided that examination shows that the case is not one of absolutely too large fœtus and that there is no immediate necessity to reduce its circumference by embryotomy, delivery should be conducted on the following lines:

1. Mechanical traction for enlarging the genital passage should always be exerted at three points in anterior presentation, and never on the fore limbs alone. To each limb a snare should be securely fixed above the fetlock joint, and not immediately above the hoofs. The head should be secured by blunt eye-hooks connected by a snare, rather than by a head snare, when the fœtus is living. Traction on the limbs effects the mechanically important passage of the elbow and shoulder joints from in front of into the pelvic ring, with expansion of the ventral section of the maternal passage; while traction on the head exerts axial force on the body as a whole in the direction of the vertebral column, and thereby leads to expansion of the dorsal section of the genital passage. On the other hand, the forcible advance of the head avoids telescoping of the neck, which is especially prone to occur in the case of a dead fœtus with dry skin.

Forcible delivery of the calf in anterior presentation should therefore be performed according to the following rules:

(a) By exerting moderate force only the head and limbs are drawn towards the pelvis.

(b) Sufficient traction is then exerted on the limbs to extend all the joints, especially the elbow joints, to the maximum; but as yet both elbow joints should not enter the pelvis.

(c) The head is next drawn into the pelvis so that the frontal eminence becomes engaged in the sacral curvature.

(d) Increased traction is then gradually exerted on one limb only until the elbow joint is drawn over the os pubis into the pelvic cavity (Fig. 65).



FIG. 64.

Simultaneous and uniform traction exerted on both fore limbs, without traction on the head, even in the living fetus, but more especially in a dead one with dry skin, results not only in arresting the shoulder and elbow joints at the pelvic inlet, but also in "telescoping" the neck muscles and skin.

(e) While traction is maintained on the limb already dealt with, the other fore limb is treated in the same way, until both digits project equally from the genital passage.

(f) The last act of delivery consists in simultaneous application of traction on all parts, until the head protrudes from the vulva, and from that point the principal traction is exerted upon the limbs again.

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promotes the adaptation of the thorax to the space available in the pelvis. This is especially seen when it is pointed out that the widest diameter of the fore part of the body, represented by the region between



FIG. 66.

Simultaneous traction on the head and limbs has resulted in direct entry of the widest diameter of the fore part of the body into the pelvis, and consequently interference with delivery (incorrect method).

the elbow and shoulder joints, does not enter the pelvis directly (Fig. 65), but obliquely (Fig. 66). For this reason the inclusion of both fore limbs in a single traction cord is to be rejected.

The technique of delivery described above is adapted to the size of the parts concerned in extraction. First the bulky parts of the body are

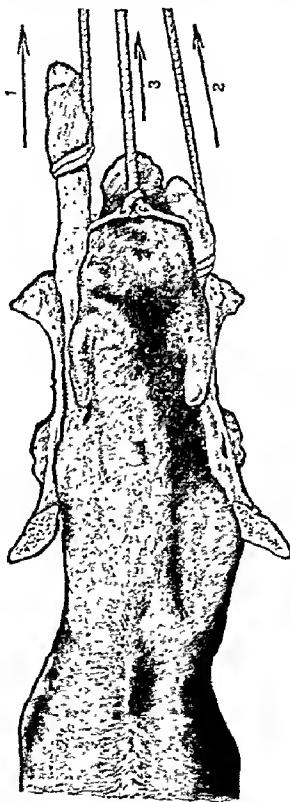


FIG. 65.

Forcible traction on one fore limb has resulted in unequal entry of the shoulder and elbow joints into the pelvic ring, and consequently oblique passage of the shoulder sirls through the pelvis (correct delivery).

placed in the correct direction, and the more slender parts can easily follow.

Alternate traction on each of the fore limbs and then on the head

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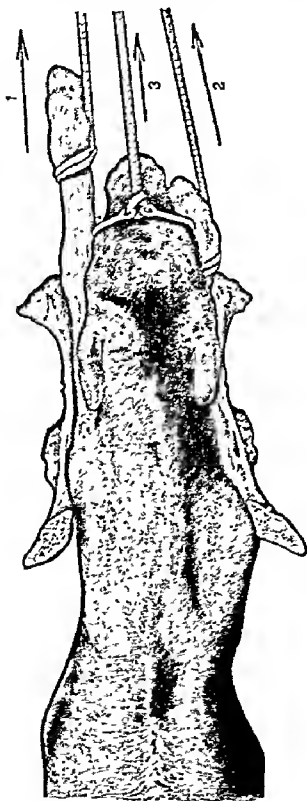


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placed in the correct direction, and the more slender parts can easily follow.

Alternate traction on each of the fore limbs and then on the head

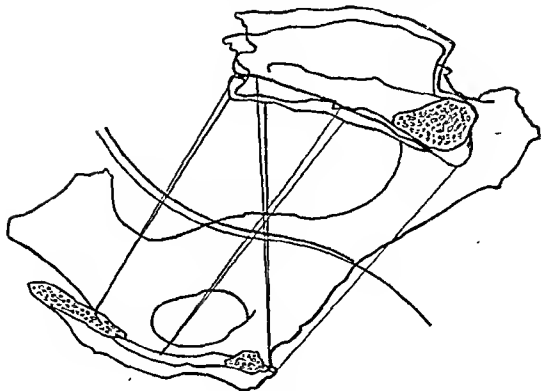


FIG. 67.

The position of the fetus in the uterus is shown in the diagram. The fetus is positioned with the head tilted back, and the body is curved. The diagram illustrates the relative positions of the fetus, the uterus, and the surrounding structures.

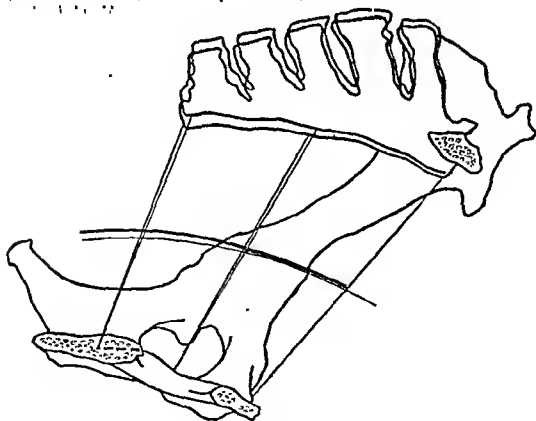


FIG. 68.

The position of the fetus in the uterus is shown in the diagram. The fetus is positioned with the head tilted back, and the body is curved. The diagram illustrates the relative positions of the fetus, the uterus, and the surrounding structures.

2. To lay down a rule as to the number of persons to be employed for traction is difficult. In deciding this point the age and strength of the assistants, the nature and mode of operation, and the breed, age and size of the animal have all to be considered.

On the whole it is best to employ several persons, but they should not exert their whole strength, nor should they apply traction jerkily.

The necessary power for extraction can only be properly exerted when each traction cord is provided with a short wooden rod about 20 cm. (9 inches) long and 2.5 cm. ($1\frac{1}{2}$ inches) thick, and there is a firm standhold for the assistants' feet. Secure knotting of the traction cord to the rod is especially to be avoided. It is best to employ a clove hitch. The adaptation of the trunk to the bony genital canal, mentioned under point (a), cannot be correctly produced if the error of using a single long snare for extraction of both extremities and the head is committed; a practice often adopted by laymen.

The delivery of a calf is considerably facilitated by accurately checking the guiding line during traction. The pelvic axis or guiding line signifies an imaginary line which connects the centre points of the whole of the pelvic section and represents, with its curvature, the course of direction of the genital canal. In this respect there are considerable differences between the mare and the cow. In the mare, owing to the wide and nearly horizontal position of the pelvic floor, the pelvic axis forms a very shallow curve decreasing caudally; whereas in the cow the pelvic axis, owing to the anterior part of the pelvic floor ascending steeply in the caudal direction, at first ascends from the pelvic inlet, then becomes more horizontal, and finally rises again towards the tail. In addition, during expulsion in the cow, owing to the marked displacement of the sacrum upwards, the guiding line presents a still larger deviation from the root of the tail than in the mare (Figs. 67, 68), because in the latter the movability of the sacrum during parturition is relatively slight. At the commencement of extraction in the cow, therefore, traction on the fœtus must be exerted more in the direction of the root of the tail, and not downwards until it has entered the pelvic cavity.

Lastly, no uniform scale can be formulated for the estimation of the degree of traction force to be applied at different ages and in different breeds, although heifers, on account of the expansibility of the pelvic ring, can withstand comparatively strong traction.

In general it may be stated that in cows of indigenous breeds of average development, uniform and steady traction in the guiding line exerted by five powerful assistants placed in the correct position is

genital passage, and therefore the operation of delivery should be methodical and comparatively slow. The head fortunately leaves the danger zone—that is, the zone in which asphyxia may occur from the inspiration of amniotic fluid—comparatively early, before the blood supply from the placenta is cut off. By stretching of the perineum from without, or, if necessary, by episiotomy in heifers, the passage of the head through the vulva is facilitated—the first important obstacle to delivery.

5. As a rule the thorax follows after alternating traction on the extremities and head. In this way the second obstacle, the delivery of the anterior part of the body, is overcome. During a short interval of rest the mouth and pharynx of the partly born fœtus should be cleansed of mucus with a clean towel after drawing out the tongue.

6. If the passage of the hind part of the fœtus (the third and last obstacle) presents difficulty on account of the simultaneous entry of the often well developed stifle joints into the relatively narrow ventral section of the pelvic inlet, displacement of the joints should be brought about and subsequent replacement in the largest diameter of the pelvic inlet—i.e. the oblique diameter. This may be effected in the following way: a dry towel is laid round the part of the fœtus already born, so that the body can be firmly grasped. It is then rotated through an angle of 30–60 degrees on its longitudinal axis. Delivery is then completed by lateral traction on the part already born.

Indications for Embryotomy. Dismemberment of the fœtus is performed, with the object of reducing the dimensions of the thorax, by the subcutaneous or percutaneous removal of one or, more rarely, both fore limbs. If this procedure is prevented by the presence of the head, the latter is amputated. When this partial embryotomy proves insufficient for the purpose of delivery, total embryotomy must be performed—transverse division in the lumbar region, followed by sagittal section of the hind parts.

An oversized fœtus presented by the head also forms a suitable case for perforation of the vertebræ with the rachiphore or for embryotomy using the vakufakt. For completion of the operation division of the posterior part of the body either in the sagittal or in a diagonal plane with a wire or chain saw is usually necessary. The chain saw is suitable only for axial section in the direction of the vertebral column. The previous transverse amputation at the lumbar region facilitates division of the pelvic girdle.

sufficient for the extraction of an absolutely or relatively large foetus without injury to the mother. The greater the attention paid to preparation and technique, the less is the force required. The force expended should not, as a rule, be so powerful as to move the whole animal backwards, but in small subjects this rule is not hard and fast. If such a degree of traction fails, the operation for reducing the circumference of the foetus is to be conducted without delay.

3. With regard to the use of mechanical apparatus or similar devices for effecting forcible extraction, such as the arbour wheel, pulleys, the force of a tethered horse, etc., it has for decades been taught in the Vienna school that all force which is exerted by mechanical aids such as these, and not by assistants who can be controlled, is absolutely contraindicated, for the following reasons:

(a) The operator is not in a position to assist in the natural process of accommodation of the various parts of the foetus to the maternal canal, and especially he is unable to maintain the correct direction, because the foetus forms a rigid body and enters the pelvis abruptly with its largest diameter presenting, without any preparation for the corresponding conditions of space.

(b) By these methods the force exerted is absolutely uncontrolled and must lead to severe injury unless especially favourable conditions are present in the genital passage. The manner in which the mother is fixed when this type of traction is applied also requires consideration.

One special delivery apparatus consists of a strong, oval iron ring, which is connected through a system of poles with an axle which is worked by a crank and cogwheels. The traction cord is attached to the axle. During the working of the crank the iron ring rests against the maternal pelvis and the foetus becomes to a certain extent "cranked" from the pelvic cavity. When other mechanical aids are used, such as pulleys or tethering to a horse, etc., the hind-quarters of the cow are fixed to a firm support (strong ladder or post) or the animal is prevented from moving backwards by chaining its horns to the manger. Dangerous fissures and fractures of the pelvis or dislocation of the ischium are not uncommon results of this rough procedure, as also is fracture at the root of the horn.

Any obstetrical instrument which cannot be used without danger to the mother is not of scientific importance, least of all the delivery apparatus and similar devices.

4. The passage of the foetus through the pelvis in anterior presentation requires time for the adaptation of the relatively large thorax to the

B. Posterior Presentation

On examination the hind limbs are found to be more or less advanced and the fœtus lying in the dorso-sacral position. Delivery is effected on the following principles:

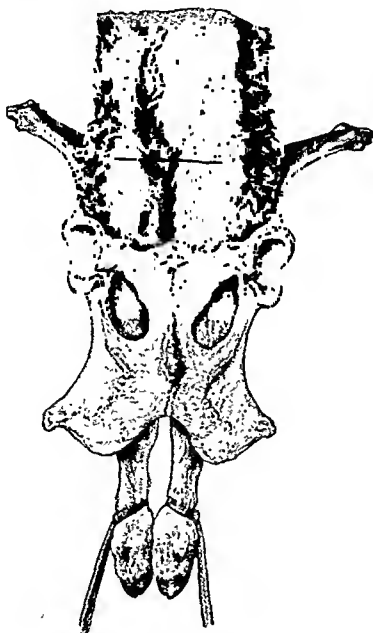


FIG. 70.

1. In contrast to anterior presentation, the extraction of the fœtus in posterior presentation must be completed as rapidly as possible, for owing to pressure on the umbilical cord during passage of the hind

With the aid of the roller embryotome total embryotomy can be performed in a special way and completed by axis section (Glättli spiral) through the pelvic girdle.

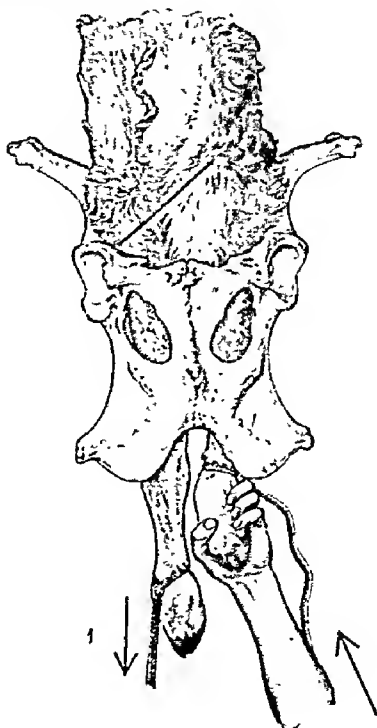


FIG. 69.

of both stifle joints into the pelvis is avoided (Figs. 69 and 70). In addition the relatively largest diameter of the fœtal pelvis—i.e. the distance between the two stifle joints—does not enter the pelvis transversely in the narrow ventral section of the pelvic inlet, but obliquely

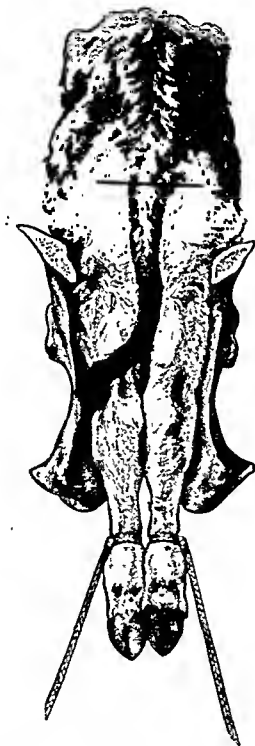


FIG. 72.

Simultaneous traction applied to both extremities from the outset has resulted in obstruction (direct entry of the largest diameter of the fœtal pelvis into the maternal pelvis).

quarters through the pelvis there is a danger of death of the fœtus from anoxæmia.

2. At first strong unilateral traction should be exerted on one limb while the other is kept forward. In this way the simultaneous entry

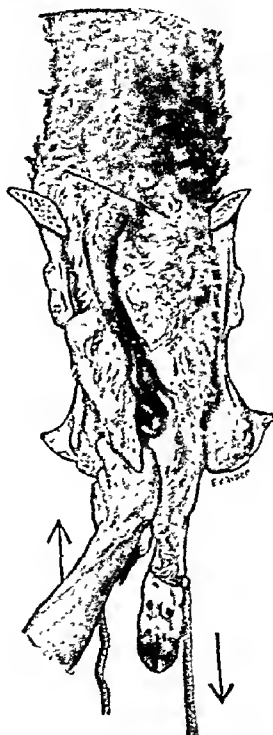


FIG. 71.

posture, but on the whole this condition is less common than in the cow. This fact is due, on the one hand, to the relatively slender body of the foal with its less strongly developed muscles and joints as compared with the calf (at any rate, this is the case in the finely bred fast breeds, although in the coarse, slow breeds the opposite is not infrequently the case), and, on the other hand, to the more favourable conditions with regard to space in the pelvis of the mare, especially in its transverse diameter.

In general the same principles for delivery hold good as in the cow, but with the following differences:

1. As a foal is generally more liable to succumb than a calf, it is advisable to perform all obstetric operations quickly.

2. The shape of the head and trunk in foals conforms with rapid extraction, and apart from this the parts of the fœtus which become so readily obstructed in the cow (head, thorax, pelvis) are easily passable. Exceptions to this rule, however, are sometimes met with in coarse breeds.

3. During delivery special care must be taken regarding traction on the head (eye hooks). When such traction is necessary its force should not exceed that of one man, as the bones of the skull are less resistant in the foal. Not infrequently in anterior presentation the posture of the head is abnormal. It is rotated on its axis, the brow being turned towards the limbs. This posture should be corrected before extraction, as it requires both hands. For details of the use of eye hooks, see under "Lateral Posture of the Head."

4. Obstruction to delivery by the hind parts of the fœtus when the anterior parts have navigated the pelvis is still rarer than by the anterior parts themselves, owing to the favourable form of the pelvis in the mare. Rotation of a firmly impacted hind part from the upper to the semi-lateral position is therefore not necessary.

B. Posterior Presentation

For the delivery of this presentation the same principles and precautions are to be observed as in the cow.

Indications for Embryotomy. Large foals presented normally in either anterior or posterior presentations seldom necessitate recourse to embryotomy. When it is necessary the same rules apply as in the cow.

to the sagittal plane. Not until one stifle joint has been drawn over the pelvic brim should the second limb be drawn back.

Further, by separate traction on each limb in turn the widest transverse diameter of the foetal pelvis does not enter the maternal pelvis in its shorter transverse diameter, but in its longer oblique diameter. In this way the passage of the foetus takes place not in the dorso-sacral position but in a semi-lateral position (Figs. 71, 72). If this partial rotation does not occur automatically when dealing with the limbs, it must be brought about, before proceeding with the extraction, by crossing the limbs or by rotating the foetus with a wooden bar fixed between the metatarsal bones, and initial traction applied to the lower limb.

3. With regard to the force and direction of traction, the principles to be complied with are the same as in anterior presentation.

4. As soon as the hind part of the body is born, the fore part usually follows rapidly. For the passage of the foetus presented posteriorly, one obstacle only has to be overcome, and that is the foetal pelvis. The mechanical conditions for delivery are therefore much more favourable in posterior than in the anterior presentation. It is occasionally only that obstacles are caused by obstruction at the shoulder girdle or by malformations of the head, such as dicephalus, hydrocephalus, etc.

5. After delivery of a posterior presentation, the foetal mouth and pharynx require even more careful attention with regard to the removal of mucus, because in delivery in the posterior position the danger of asphyxia is greater than in anterior presentation.

Indications for Embryotomy. The first operative step is the removal of the hind legs subcutaneously or percutaneously. The hind part of the body can then be extracted either without or after evisceration, employing a lateral incision into the abdominal cavity. If the foetus cannot now be extracted by moderate traction owing to the great size of the anterior part of the body, partial transverse amputation behind the shoulder blades, followed by sagitto-diagonal separation of the thorax, is the quickest method. The operation is facilitated by fixing the stump of the thorax by double hooks.

Embryotomy performed with the rachiphore or vakufakt requires a special technique (p. 271).

THE MARE

A. Anterior Presentation

By Increased Traction.—In the mare obstruction to delivery may be caused by the absolute or relative oversize of the foetus in the extended

on the lateral wall of the thorax, in others it is directed more caudally towards the flank, whilst in the remainder it is completely backwards and out of reach of the hand. This last type is especially common in foals, owing to the longer, slender neck and weak development of the muscles of the trunk. In some cases the head presents pronounced deviation in the dorsal direction. Not infrequently it is rotated on its axis, with marked lateral or dorsal direction of the lower jaw (Fig. 73). This rotation is usually the result of lay interference due to traction on a snare incorrectly applied to the lower jaw.

Congenital curvature of the cervical vertebræ with lateral deviation of the head sometimes simulates lateral head posture. This malformation occurs comparatively often in foals, but is rare in calves. It is indicated by a springing back of the distorted vertebræ when attempts at extension are made. It is generally accompanied by similar malformations of the limbs with shortening of the flexor and extensor tendons.

THE COW

Mechanism of Correction

Treatment must always aim at correction of the posture of the head. It may be carried out in several ways:

1. *With the Hand Alone.* The first essential for success is some degree of mobility of the head and neck; and thus the elimination of abdominal pressure by the use of epidural anæsthesia, and in protracted cases the infusion of a sufficient quantity of linseed mucilage are of great importance. In addition the cow must be so placed that the displaced head lies against the free, upper side of the maternal abdomen.

The correction of the posture of the head and its entry into the pelvic canal is accomplished in three stages. Stage I (Fig. 74): using the hand corresponding to the side to which the head is displaced, the operator grasps the foetal mouth. Stage II (Fig. 75): by supporting his upper arm and elbow on the floor and lateral wall of the pelvis, lateral pressure is exerted on the foetal head so that it is moved towards the median line until the hand and arm are nearly parallel to the longitudinal axis. Stage III (Fig. 76): the head can now be brought into the pelvic cavity without hindrance by several methods. (1) While it lies to some extent on the forearm, rotation of the head laterally and towards the pelvis is effected by means of the fingers placed over the muzzle and simultaneous pressure made against the lateral aspect of the face with the palm of the

position, behind the spoon-shaped enlargement of the body of the mandible, slipping is practically impossible (Figs. 79 and 80).*

After the ineffective employment of a mandibular snare by laymen,

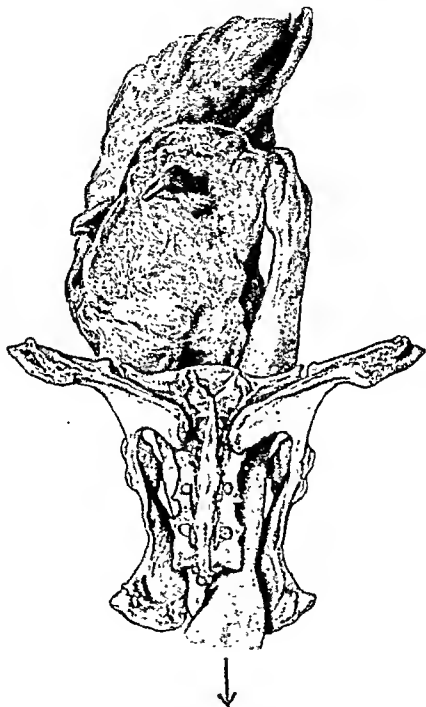


FIG. 75.—CORRECTION OF LATERAL POSTURE OF HEAD BY THE HAND ALONE (SECOND STAGE).

* It nearly always obviates the necessity of fixation of the snare by Williams method, in which the free end of the traction cord is passed through an incision made between the rami of the mandible behind the incisor teeth.

hand. (2) The orbital groove is grasped by the thumb and middle finger (forceps grip) while the head is raised and the neck extended (Fig. 77). (3) With the hand in the form of a wedge the lower jaw is grasped and drawn backwards by the thumb and index finger (Fig. 78).

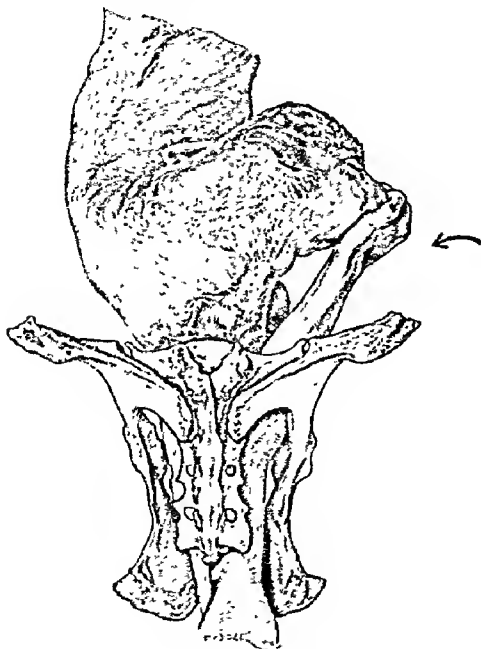


FIG. 74.—CORRECTION OF LATERAL POSTURE OF HEAD BY THE HAND ALONE (FIRST STAGE).

2. With a Mandibular Snare. When correctly employed, this is the simplest and best method of correction. Flocked hemp only is used in a similar form to a foot snare. Caution is necessary when attaching it on account of the sharpness of the incisor teeth. When placed in the correct

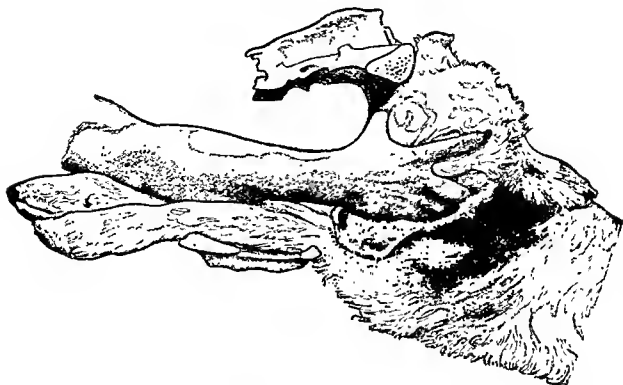


FIG. 77.—CORRECTION OF LATERAL POSTURE OF HEAD BY FORCEPS GRIP IN THE ORBITAL GROOVES.



FIG. 78.—CORRECTION OF LATERAL POSTURE OF HEAD BY GRASPING THE LOWER JAW (WITHDRAWAL OF HEAD INTO PELVIS).

the head is sometimes found in the lateral posture, but with partial or complete axis rotation (Figs. 81, 82, and 83).

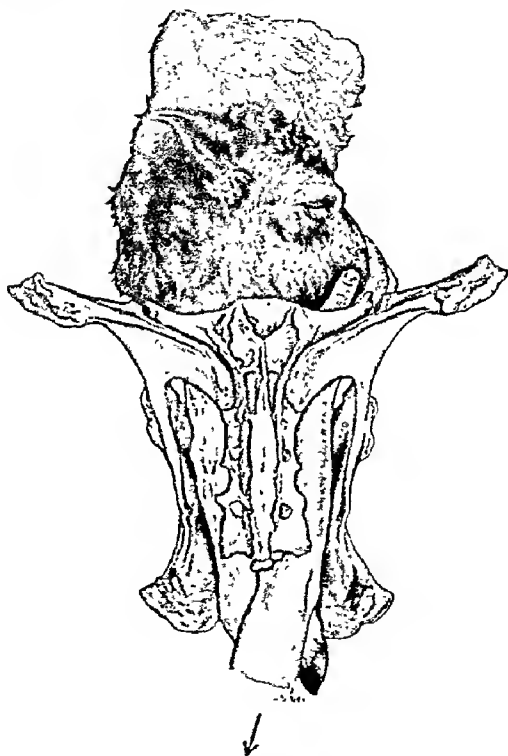


FIG. 76.—CORRECTION OF LATERAL POSTURE OF HEAD BY THE HAND ALONE (THIRD STAGE).

The reasons for this occurring are quite obvious to the expert. Correction even in these cases can be effected, but only by the application of

eyes only within reach. The most practical method is to apply both hooks on a running noose, so that when closed they exert a forceps grip in the orbital furrow. The length of the shaft of the hook must be less than half the interocular line. The ring for the traction cord should not be too large, but just of sufficient size for a thin cord to pass through it easily, so that the hooks slide readily on tightening the noose. A thick hempen snare is quite unsuitable.

Application of the hooks (Fig. 84): After determining the posture of the head (frontal surface and direction of interocular line) the hook for

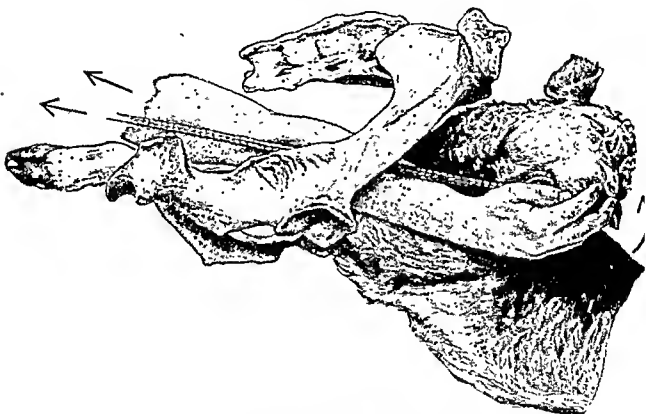


FIG. 80.—REPOSITION OF Laterally Displaced Head with Mandibular Snare.

The hand applied to the mouth acts as a guide, and at the same time protects the uterine wall against the sharp teeth.

the distal eye is introduced into the uterus in the palm of the right hand and fixed in the medial orbital canthus, while the left hand, outside the vulva, maintains the hook in position by light traction on both shanks of the noose. Traction is now exerted on the free end of the snare and the second hook is introduced in the genital passage and into the second orbit. The traction gradually tightens the noose so that the second hook passes forwards automatically along the head until both rings lie together between the eyes and the noose is completely closed (Fig. 85). Rotation of the head into the extended position by traction on the snare

two antagonistic forces—pressure against the head on one side of the occipital region and traction on the mandibular snare on the opposite side, in order to rotate the head backwards in the same plane in which it has deviated in the lateral posture. The traction cord should never pass over the neck or back to the lower jaw, but along its mandibular border or the lateral aspect of the neck. Correction of the axis rotation must always precede rotation of the head on its long axis (Figs. 82 and 83). If the head is rotated backwards in this way to such an extent that

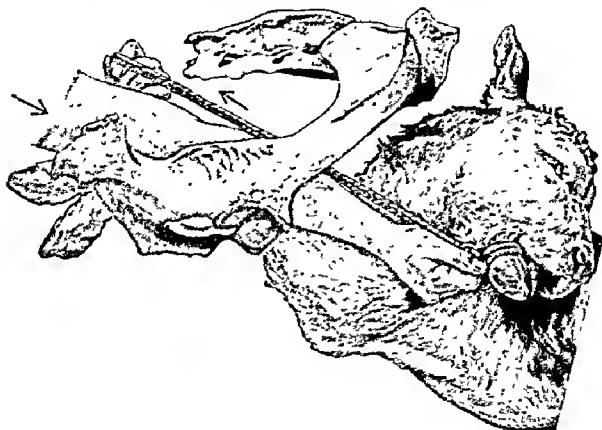


FIG. 79.—REPOSITION OF Laterally Displaced Head with Mandibular Snare (Application of Snare).

the mouth is directed laterally or towards the pelvis, the final drawing of the head into the pelvis is performed with the hand, which serves at the same time as a protection against the sharp incisor teeth injuring the soft structures (Fig. 80).

In using the mandibular snare the rule to be observed is that it must not be used for extraction, but only for redirection of the displaced head.

3. With Eye-Hooks. These are used in cases in which reposition cannot be effected by simple means, such as a fractured lower jaw or the

schau, 1925) a cord of suitable length (about 4 metres) is doubled and the loop is passed from above, around the bent neck and drawn out of the vulva. After completion of the snare by passing of the free ends

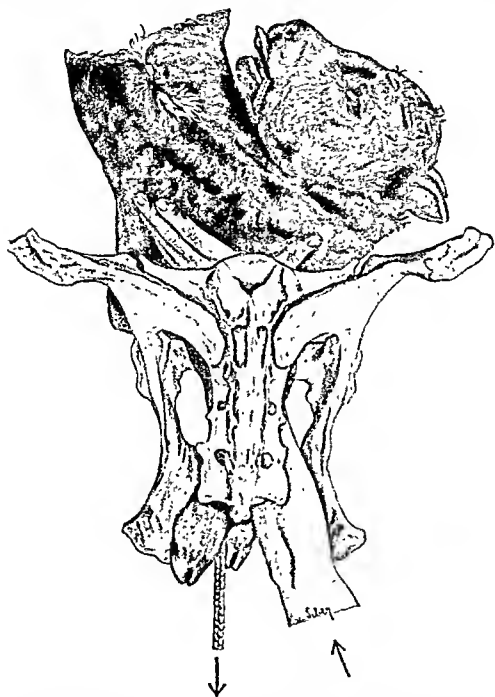


FIG. 82.—REPOSITION OF LATERAL POSTURE OF HEAD WITH AXIS ROTATION BY THE APPLICATION OF OPPOSING FORCES—THE HAND AND MANDIBULAR SNARE (CORRECT DIRECTION OF TRACTION).

through the loop, the former is passed over the head and tightened around the face between the eyes and nose.

Reposition is effected by the action of two forces—pressure of the

is performed after previous displacement of the head towards the centre of the uterus by the right or left hand (Figs. 74-77). If this lateral displacement of the head is not effected, the face becomes impacted at the pelvic inlet.

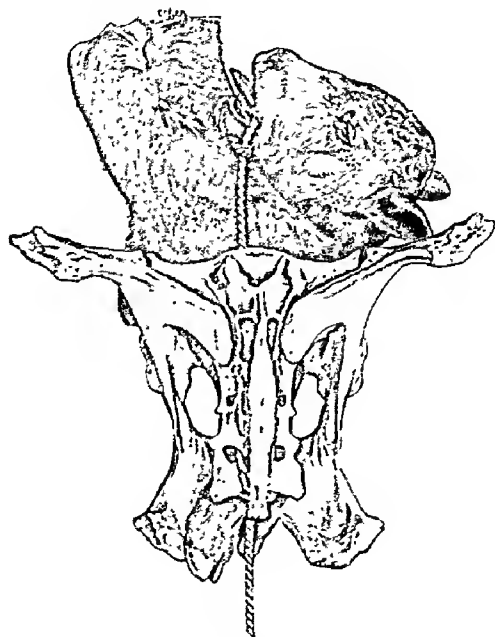


FIG. 81.—LATERAL POSTURE OF THE HEAD WITH AXIS ROTATION (INCORRECT DIRECTION OF TRACTION; LAY ASSISTANCE).

In exceptional cases a single hook only may be used, but care must be taken that it is continually pressed against the ocular groove with the hand during rotation of the head. Whenever the introduction of the second hook is possible, it should be done.

4. Using Gagny's Snare. In the original method (*Tierärztl. Rund-*

By the correct performance of the methods described, especially when the appropriate procedure is adapted to each individual case, the number of cases of lateral posture of the head requiring embryotomy is considerably reduced. All attempts to perform extraction of a calf with the posture of the head uncorrected are unscientific unless the

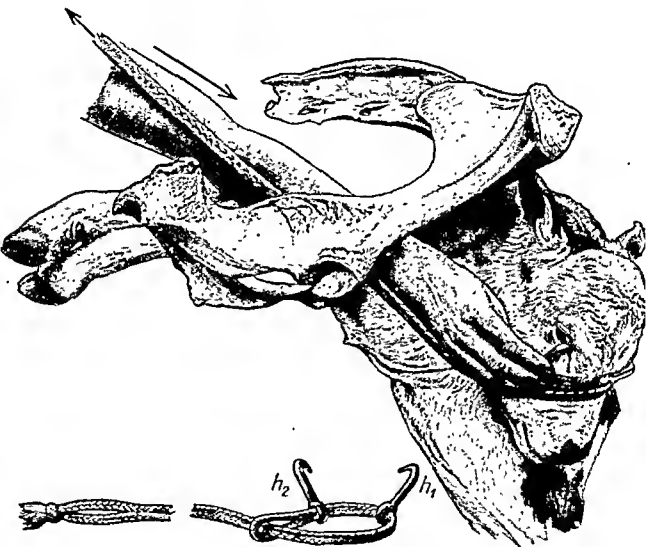


FIG. 84.—APPLICATION OF EYE-HOOKS IN LATERAL POSTURE OF HEAD.

individual conditions are very exceptional, such as a very roomy pelvis and very small foetus.

Indications for Embryotomy. Reduction of the dimensions of the foetus can be effected in three ways: (a) by decapitation and delivery of the foetus after removal of the head. This method may be dangerous in the case of a narrow, œdematous vagina or an emphysematous foetus, consequent upon injuries caused by the stump of the neck, and also the

hand against the foetal sternum and simultaneous traction on the free ends of the snare.

For the preparation of Gagny's snare the author usually employs two snares connected at the loops. He also finds by experience that when slipping of the nasal loop occurs it may with advantage be placed

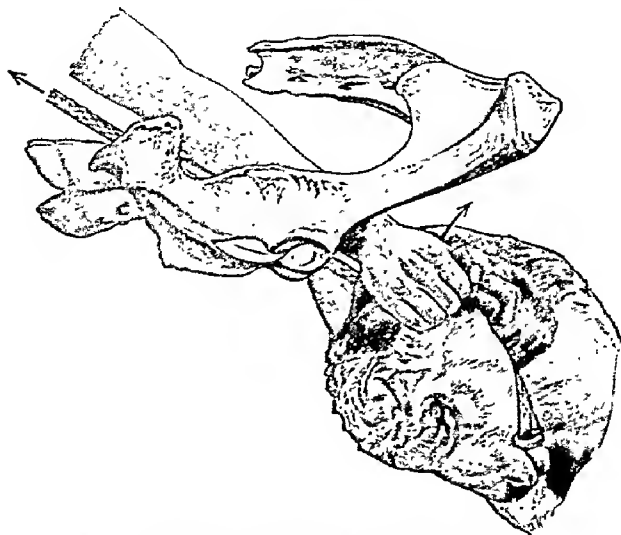


FIG. 83.--REPOSITION OF LATERAL POSTURE OF HEAD WITH AXIS ROTATION BY THE SIMULTANEOUS ACTION OF OPPOSING FORCES.

in the mouth, at the same time grasping the open mouth with the hand during rotation.

Correction of the laterally displaced head in accordance with the methods described under 1, 2, 3, and 4 can be considerably facilitated, in cases of impaction of the foetus, by repelling and maintaining repulsion of the anterior part of the body by means of a torsion crutch fixed to the fore limbs by cuffs. Complete extension of the joints, which is a *sine qua non*, is maintained by strong traction on the cords from the foot end.

mare, the mechanical conditions required for grasping the foetal head in lateral posture are better served by the recumbent position, the head becoming more accessible on account of the horizontal position of foetal trunk. The mechanics of manual reposition of the head conform with the same principles as in the cow.

2. **With a Mandibular Snare.** Owing to the smaller and less "shovel-shaped" form of the lower jaw in foals, the snare tends to be less firmly attached than in the calf. Nevertheless, when properly applied it renders valuable service, at least for the correction of the head when the face is directed towards the abdomen. Not infrequently, by careful traction, the head can even be conducted in the extended position into the pelvis. In foals also it is better that traction on the mandibular snare shall be exerted by the obstetrician himself. It is only when the power of one hand is insufficient for replacement that the traction cord should be handed to an assistant, and then explicit instructions as to the direction of traction and the degree of force to be exerted should be given by the obstetrician continuously according to the particular requirements. Throughout he keeps his hand on the mouth.

3. **With Eye-Hooks.** As in the calf, both blunt and sharp hooks may be used, but in exerting traction the lesser resistance of the skull in the foal must be taken into consideration. More frequently than in the calf one eye-hook only is used for traction on the head, because of the inaccessibility of the second ocular groove. In this case careful control of the hook, by constant pressure upon it with the hand, is absolutely necessary.

4. **With Gagny's Snare.** Correction of the lateral posture of the head is performed in the same way as in the calf.

5. **With Kühn's Crutch.** When the head cannot be reached by the hand, this method constitutes the last attempt at manipulative correction before resorting to embryotomy. With a Sehriever's introducer the cord of Kühn's crutch is guided around the flexed neck from above below, drawn out from the vulva, and then passed through the eye of the fork. The crutch is introduced, whilst maintaining light traction on the free end of the snare to the point of flexion of the neck. By guidance with the hand, it is passed along the outer side of the neck until the fork is adjacent to the angle of the mandible. The snare around the neck tends naturally to follow it, especially if semicircular rotatory movements are carefully exerted on the fork (Fig. 87). With simultaneous manual counter-pressure the snare is now drawn taut and secured to the handle. The crutch is thus fixed to the head end of the neck so that

absence of a central working point. (b) By removal of the limb and shoulder blade lying opposite the displaced head, and subsequent correction of the head posture. (c) By means of the vakusakt a section of the cervical vertebræ may be sawn off at the point of curvature with the aid of the harpoon hook, in the same way as in dorso-transverse presentation; in order to facilitate correction of the head.

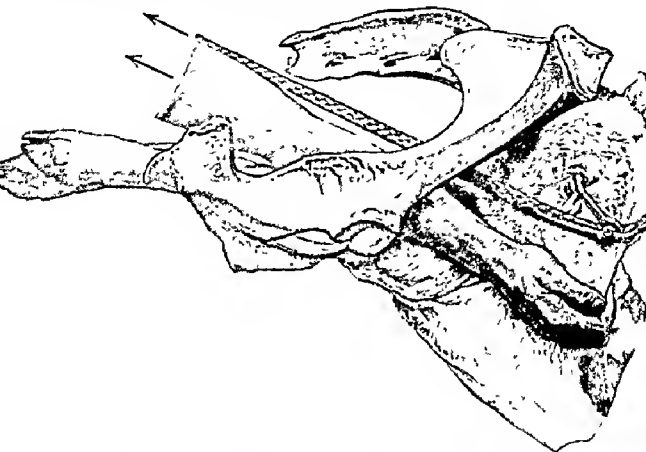


FIG. 85.—MANUAL ASSISTANCE DURING TRACTION ON THE EYE-HOOKS.

THE MARE

Mechanism of Correction

Although in exceptional cases, especially with small foals, delivery may be possible with the head in the lateral posture, the first rule in the mare, as was the case in the cow, is correction of the displacement. This may be effected by the following methods:

1. *With the Hand Alone.* This can only be successful when the head and face are within reach, and thus an obstetrician with a long arm has an advantage. Reposition is greatly facilitated by the use of epidural anæsthesia.

Whilst the general rule that correction of posture is more simple in the standing than in the recumbent position also holds good for the

of reach of the hand or can only be touched with the finger tips, hut it also fixes it, and thus traction can be applied to the head itself rather



FIG. 87.—CORRECTION OF LATERAL DISPLACEMENT OF THE HEAD, USING THE CRUTCH.

Stage II.—After being fixed in position the fork is rotated 90 degrees so as to lie on the throat, and the snare is drawn taut. The head end of the neck is, so to speak, strangled.

than to the point at which the neck is flexed—an important point in the mechanics of reposition (see Figs. 86, 87 and 88).

By strong traction on the crutch the head, originally lying deeply in

the fork lies on the outer or towards the ventral side, while the loop passing perpendicularly to the vertebral column, strangles, as it were,

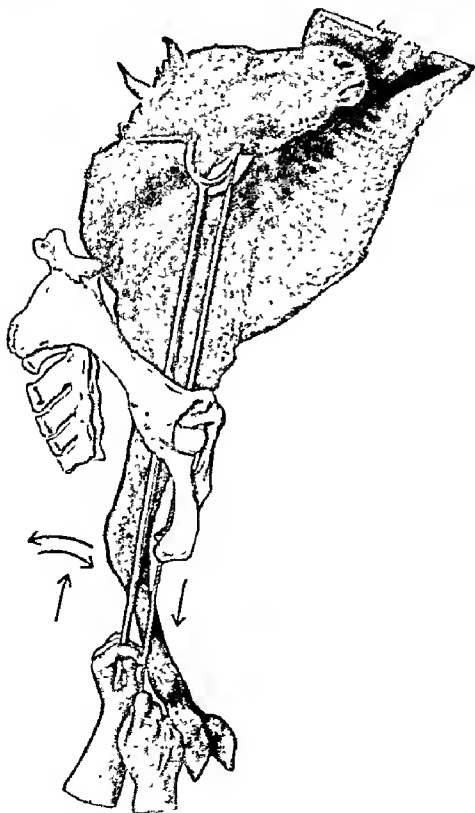


FIG. 86.—CORRECTION OF LATERAL POSTURE OF HEAD IN FOAL BY THE CRUTCH WHEN THE LENGTH OF THE ARM IS INSUFFICIENT FOR THE PURPOSE.

Stage 1.—The loop of the snare passing around the flexed neck is pushed towards the head by semicircular rotatory movements of the fork, the snare being held slightly tense.

the neck at the head end. By means of Kühn's crutch, therefore, not only can the snare be attached to the head end of the neck, which is often out

operation an unjointed crutch only is suitable. The face now being directed towards the pelvis, the head can be guided into the pelvic cavity. Traction on the crutch assists delivery (Fig. 88).

(b) When the force of the hand alone grasping the lower jaw is insufficient to rotate the head and guide it into the pelvis, a mandibular snare or eye hooks may be employed to obtain a point of action for traction. In this case, however, traction should not be exerted until the crutch has been removed.

If forced extraction of the foetus with lateral displacement of the head uncorrected is to be attempted, it must be decided in each individual case to which part the strongest traction is to be applied, either the extremities or point of curvature of the neck. In all cases in foals it must be definitely determined whether there is congenital curvature of the cervical vertebræ before commencing.

Indications for Embryotomy. On account of the favourable conditions of space in the pelvis in the mare and the anatomical characters of the body of the foal—the relatively small width of breast and the long, slender neck—division at the curvature of the neck is the first consideration. It is most important when there is a suspicion of congenital curvature to ensure protection of the vagina against injury by the stump during extraction. Removal of the free fore-limb from the thorax is only to be considered when the curvature of the neck cannot be reached for the introduction of a saw. As a rule, approach to the cervical curvature for the purpose of amputation can be effected by the use of double hooks.

B. Breast-Head Posture (“Head-Breast Position” or “Head Prolapsed between the Fore Limbs”)

In comparison with lateral displacement, this abnormality is not very common in either the cow or the mare.

Degrees of Displacement

(a) **Vertex Posture: *Vertex Presentation* (Franck).** The head rests with the bridge of the nose against the border of the pubis and the brow is directed into the pelvic inlet (Fig. 89). In hydrocephalus deviation of the head at right angles to the horizontal position is a natural consequence for mechanical reasons.

(b) **Nape Posture: *Nape Presentation* (Harms).** The head is displaced ventrally still further or is flexed against the throat so strongly that not

the uterus, can now be drawn towards the maternal pelvis into a position whereby the usual methods of correction can be performed without difficulty. The two ways are:

(a) The mouth is grasped and the head rotated on its long axis so



FIG. 88.—CORRECTION OF LATERAL DISPLACEMENT OF THE HEAD, USING THE CRUTCH.

Stage III.—After slow, forcible traction on the crutch, the head has approached the pelvis so far that it can easily be grasped at the mouth end by the hand. The crutch renders good service in the subsequent lifting and introduction of the head into the pelvis.

that the brow becomes directed first laterally, and then dorsally, towards the maternal sacrum. This procedure can be facilitated, when the crutch is fixed to the throat, by rotating the former upwards at the same time, and thus the head is raised by the fork. For this

only the vertex but also part of the nape of the neck is directed towards the pelvis (Figs. 90 and 98). Both degrees of deviation occur, especially in foals (often with a "clasp-knife" bending of the nape, the lower jaw being in contact with the lateral region of the larynx), owing to the great mobility of the long, slender head and neck. In the calf, with its plump, short, and broad neck and less mobile head, this form of deviation is exceptional.

(c) **True Breast-Head Posture.** The ventrally flexed neck is situated between the two fore limbs, the jaw being adjacent to the sternum. Although all these forms of displacement may originate from "internal causes" and from precipitate labour, true breast-head posture is, as a rule, due to hasty lay interference—traction on the limbs before the complete extension of the neck has occurred.

THE COW

Mechanism of Correction

1. **With the Hand Alone.** Slight degrees of displacement (vertex and nape postures) without impaction of the head between the limbs can, after the elimination of straining by epidural anæsthesia, be easily

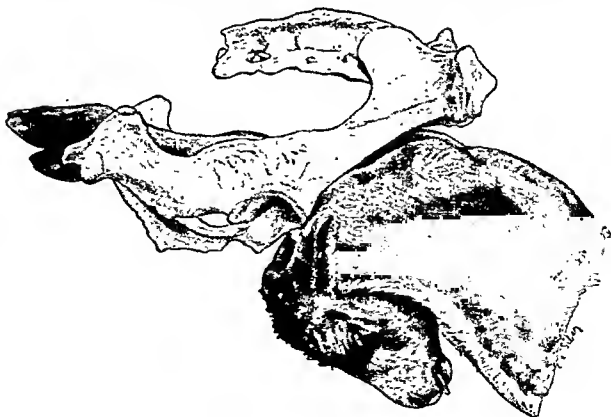


FIG. 91.—BREAST-HEAD POSTURE.

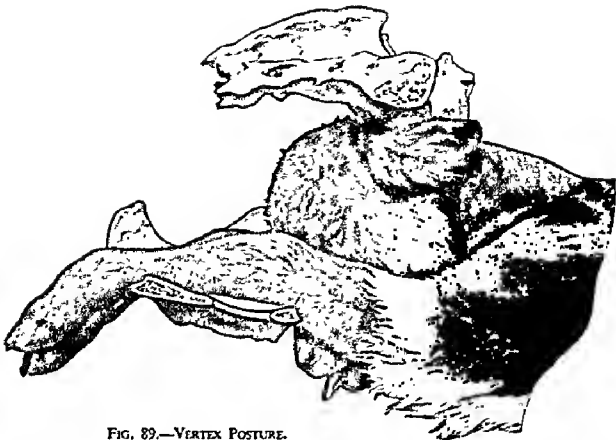


FIG. 89.—VERTEX POSTURE.

In the cow, owing to the relatively wide head of the fetus and the narrow pelvic inlet, this posture is less common than in the mare. In both species, however, the flexed head may lie to one side of the limbs.

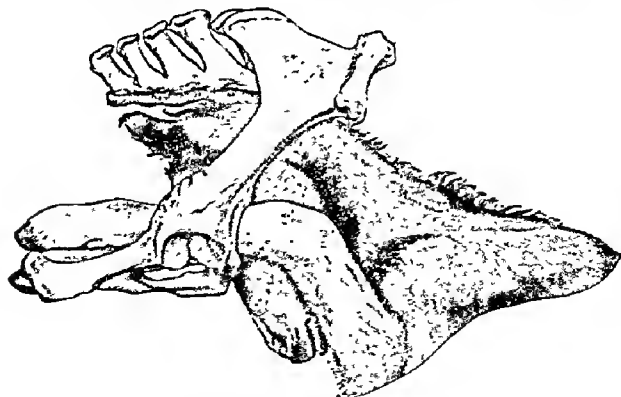


FIG. 90.—NAPE POSTURE.

The flexed head may also lie laterally to the limbs. Not infrequently this presentation is combined with faulty posture of the fore limbs (unilateral or bilateral carpal flexion).

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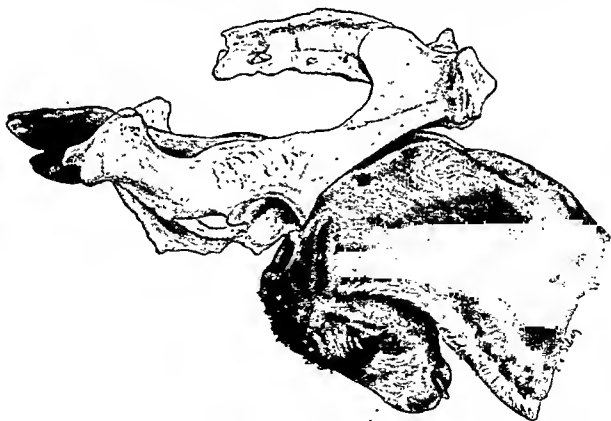


FIG. 91.—BREAST-HEAD POSTURE.

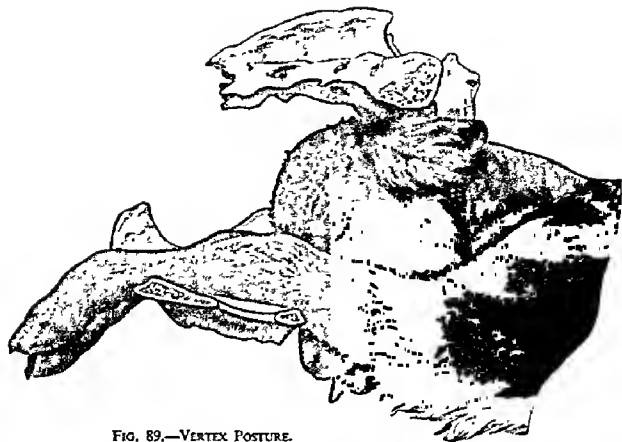


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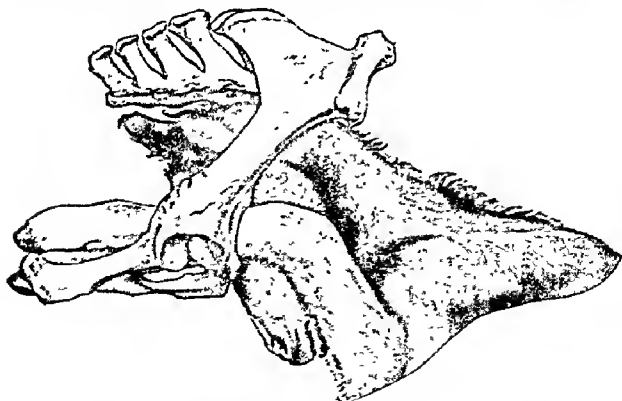


FIG. 90.—NAPE POSTURE.

The flexed head may also lie laterally to the limbs. Not infrequently this presentation is combined with faulty posture of the forelimbs (unilateral or bilateral carpal flexion).

the prongs of the fork is carried along the bridge of the nose and into the mouth, while the fork itself lies against the roots of the horns (Figs. 92 and 93).

After tightening the snare, the head is elevated and also extended by forward and upward pressure with the crutch, and lifting with the fingers on the side mouth or under the jaw. By this means reposition is effected not in the sagittal but in the oblique plane, under lateral curvature of

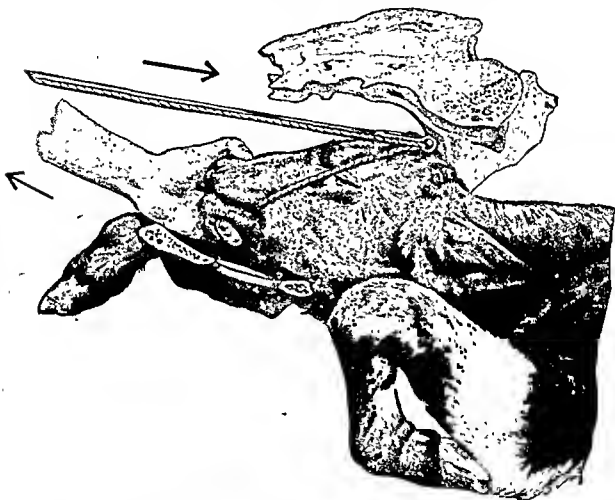


FIG. 93.—VERTEX POSTURE—THE ACTION OF ANTAGONISTIC FORCES IN REPOSITION OF THE HEAD.

The cervical vertebræ are flexed dorsally or laterally during correction of the posture.

the neck. The stronger the pressure on the one point (vertex), the stronger also is the traction on the other (mouth).

Care is necessary to ensure that the open mouth is guided into the pelvis at the appropriate time—that is, after the head has been raised sufficiently high by the crutch.

In cases where the application of the snare to the mouth is prevented by lack of space, due to the presence of both fore limbs, one of these must be replaced into the uterus (*vide infra*).

rectified as follows: The hand is introduced along the side of the face and the fingers directed around the border of the lower jaw. Whilst the fingers serve to raise the jaws, powerful pressure by the thumb as high as possible on the forehead serves to repel the head. In this way it is possible to extend the occipito-atlantal joint and guide the head into the pelvis in a state of extension. The procuring of space in the pelvis and

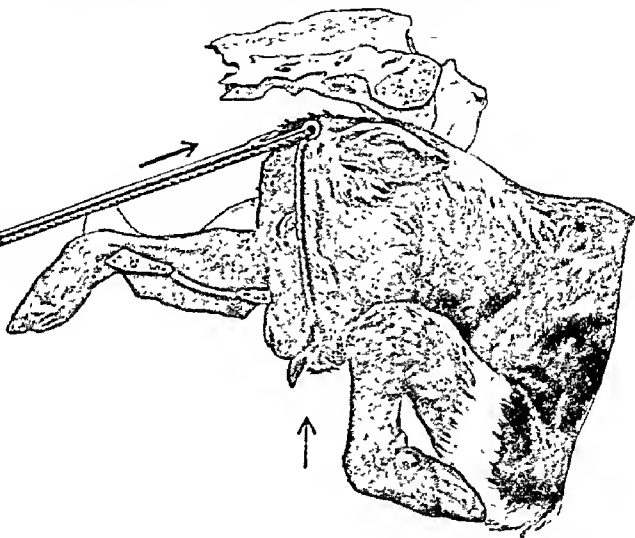


FIG. 92.—VERTEX POSTURE—CORRECTION, USING THE CRUTCH.

After displacement of one limb into the uterus, it is usually easy to introduce the loop of the snare into the mouth. The fork of the crutch should lie as high as possible on the occiput at the level of the horns.

the elimination of straining are the principal requirements for successful reposition. The use of the mandibular snare is generally unnecessary in the cow.

2. With Kühn's Crutch. In cases in which the previous method has failed or in pronounced nape presentation, elevation and extension of the head can be effected with Kühn's crutch. The snare passing between

the fœtus is not too firmly impacted, with the hand alone. Otherwise a mandibular snare must also be employed.

The reduction of the displaced limb is carried out immediately after extension of the head, sometimes before the latter has passed the pelvic inlet, or it may be delayed until after maximum extension of the neck by forcible traction on the head with the aid of eye hooks has been effected (Fig. 96). If the second fore limb or firm impaction of the fœtus below the brim of the pelvis offer obstruction to elevation of the head, the former is flexed and displaced as far as possible into the uterus and a snare is fixed to the lower jaw. After light and well-controlled traction on the snare the head can, as a rule, be raised by slight lateral turning sufficiently for the hand to be introduced to grasp the brow, if possible by inserting the thumb and middle finger into the ocular groove.

In this procedure the action of double forces is produced as follows: Traction on one end of the head (lower jaw) is opposed by equal or stronger pressure on the other end (brow and nape) until extension is complete. Correction of the displaced limb or limbs, when carried out before the head enters the pelvis, is usually effected without much difficulty. The method suggested in some textbooks of attaching a traction cord to the foot before correcting it, with the object of producing rapid reposition after correction of the head, has in the author's opinion no advantage, for several reasons. Firstly, reposition of the head is hindered by the pressure of the traction cords lying in the vagina, especially when both extremities are displaced and corded; and, secondly, the employment of the hand in extending and drawing the limb into the pelvis is always necessary.

4. *With the Mother in the Dorsal Position* (Fig. 97). Manual reposition of the head prolapsed between the fore limbs is impracticable with the mother in the recumbent (sterno-abdominal) or standing positions, but it can often be easily effected in the dorsal and high pelvic positions. The fœtus, owing to its weight, falls against the maternal spine (the principle of the displaced part lying upwards) and the obstruction due to the brim of the pubic bones is eliminated. The head can then be more easily guided into the pelvis by the hand alone without the aid of a snare on the lower jaw.

5. *With the Fœtus in the Dorsal Position.* This is the last manipulative method before resorting to embryotomy. The method recommended by Becker, in which the correction of posture is not attempted until the fœtus has been rotated into the dorsal position by means of a rod passed between the tied digits protruding from the vulva, cannot always be

3. **After Displacement of a Fore Limb.** The correction of cases of maximum flexion of the head towards the breast (Fig. 91) presents great difficulty, because the space between the two limbs lying in the pelvis is so narrow. In addition, extension of the head in the sagittal plane is impossible on account of its being beneath the border of the os pubis.

Forcible extraction in this form of malposition is absolutely contra-indicated on account of its inevitable failure.

The following method is often successful in a very short time: To obtain sufficient space, one or both limbs are returned into the uterus

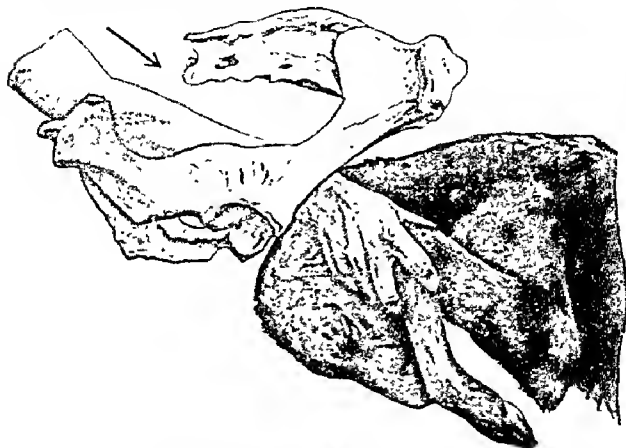


FIG. 94 — CORRECTION OF BREAST-HEAD POSTURE.
Stage I.—Procuring space by displacement of one fore limb.

as far as possible by flexion at the carpal, elbow and shoulder joints (Fig. 94). The head, grasped at the mouth, is then rotated, not in the sagittal but in the transverse plane, until the arm is situated approximately parallel with the direction of the pelvic floor (Fig. 95). This change of position is only practicable when, with simultaneous elevation of the face, the whole head is displaced dorsally and to the opposite side, above the extended second limb. This can be attained only by lateral bending of the neck. With practice and by suitable preparation of the mother, outward elevation of the head can be performed, in cases where



FIG. 96.—CORRECTION OF BREAST-HEAD POSTURE.
Stage III.—After correction and fixation of the head the displaced limb is again drawn into the pelvis. If necessary the head can be fixed by eye-hooks whilst it is still in front of the pelvic inlet before the displaced limb is corrected.

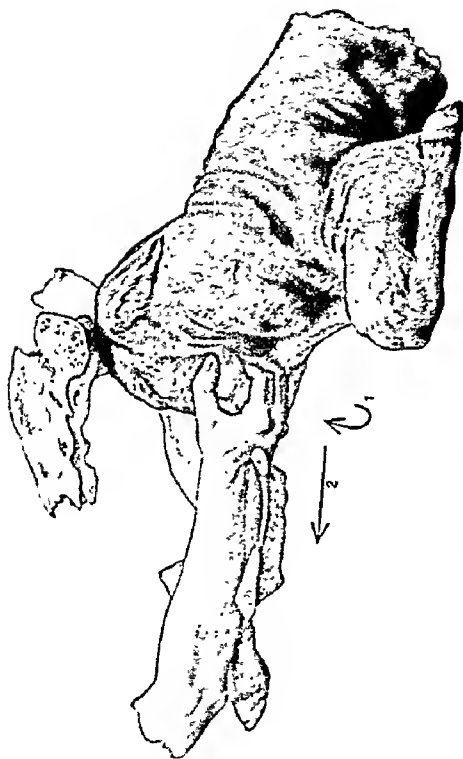


FIG. 95.—CORRECTION OF BREAST-HEAD POSTURE.

Stage II.—After replacement of the one fore limb the muzzle is grasped and the head rotated laterally to the level of the pelvic inlet. Simultaneously with this movement of rotation the whole head is moved towards the pelvic roof. For this purpose lateral bending of the neck is necessary.

THE MARE

Mechanism of Correction

1. Using the Hand alone (the Use of Combined Forces). Only cases with a slight degree of vertex presentation are suitable. Extension of the neck is effected by grasping the mouth with one hand whilst applying counter-pressure against the brow and vertex with the other.

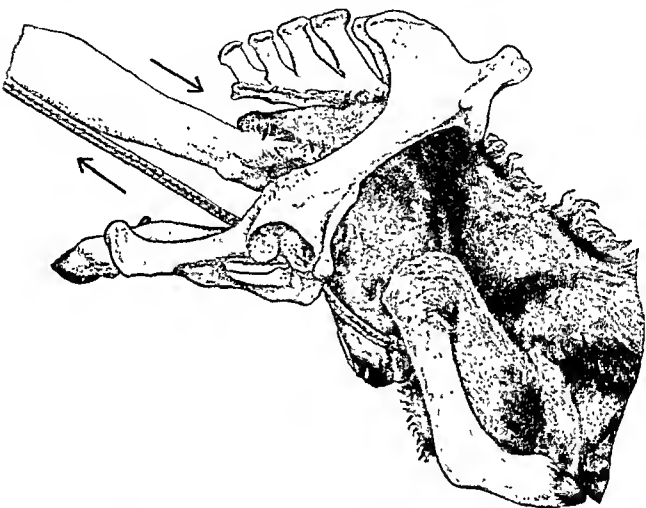


FIG. 98.—CORRECTION OF NAPE PRESENTATION IN FOAL WITH THE MANDIBULAR SNARE AFTER PREVIOUS REPLACEMENT OF ONE FORE LIMB.

The simultaneous action of antagonistic forces.

2. With a Mandibular Snare (Fig. 98). This is indicated in pronounced nape presentation, because, owing to the relatively long head acting as a lever, one hand alone is insufficient to operate upon two points simultaneously and in opposite directions. After the snare has been firmly fixed to the body of the lower jaw, one hand controls the traction cord while the other hand applies pressure to the brow and vertex. By traction on the mouth, the head and nape are displaced forwards and upwards

successfully carried out in the calf. Often the limbs project from the vulva by the boofs only, and forcible withdrawal of the metacarpi (the only suitable position for fixing a rotation rod) results in the flexed neck with the head becoming impacted in front of and below the pelvis. Consequently, rotation is difficult to perform and is always associated with a danger of rupture of the uterus.

This disadvantage can be completely eliminated by the use of Cämmerer's torsion fork. This is applicable whatever length of the limbs is exposed from the vulva, and possesses the great advantage that the

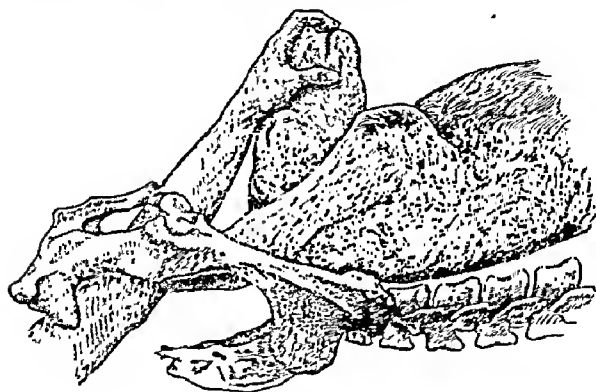


FIG. 97.—CORRECTION OF BREAST-HEAD POSTURE WITH THE MOTHER IN THE DORSAL POSITION.

In cases where the limbs are a hindrance they are flexed and replaced in the uterus. They are left in this position until extension of the head has been effected.

fœtus, fixed by the fore limbs, is during rotation simultaneously repelled from the region of the pelvic inlet. This instrument is applied in the same way as in a ventral position.

Indications for Embryotomy. Operative procedures correspond fundamentally to those in lateral posture of the head. Either the neck is severed (in vertex and nape presentations at its junction with the head), preferably by the use of the wire-saw embryotome; or, in the true breast-head posture, one or both fore limbs are removed, and then the posture of the head is corrected.

THE MARE

Mechanism of Correction

1. Using the Hand alone (the Use of Combined Forces). Only cases with a slight degree of vertex presentation are suitable. Extension of the neck is effected by grasping the mouth with one hand whilst applying counter-pressure against the brow and vertex with the other.

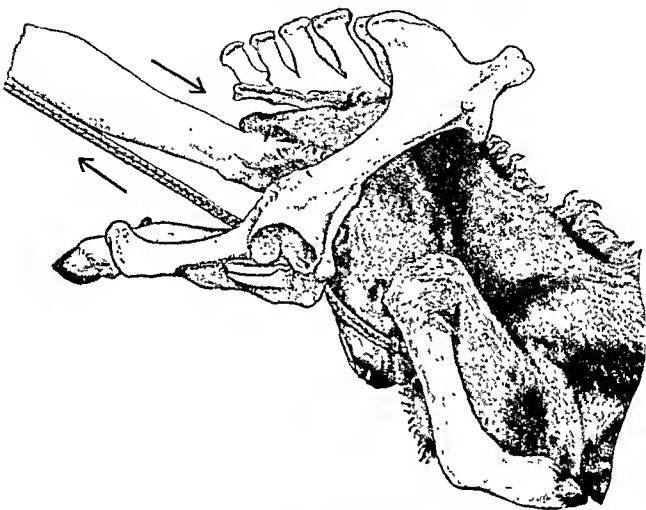


FIG. 98.—CORRECTION OF NAPE PRESENTATION IN FOAL WITH THE MANDIBULAR SNARE AFTER PREVIOUS REPLACEMENT OF ONE FORE LIMB.
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(or laterally) until the angle formed by the axis of the neck and head is opened to more than 90 degrees. After this the face usually glides spontaneously into the pelvis, sometimes before the snare has been detached from the lower jaw. In the foal the "snout" form of the upper jaw forms a suitable position for attaching a snare.

The traction cord of the snare, with the object of directing and controlling the force of traction, should be passed over the shoulder of the operator and held taut by an assistant.

3. **With Kühn's Crutch.** The correction of nape presentations is carried out in the same way as in the cow. Extension of the head at the occipito-atlantoid joint in foals, however, requires greater lateral deflection of the neck than in the calf, because the spatial conditions towards the dorsal vertebræ of the mare and the articular mechanism of the cervical vertebræ of the foal (with its strong *ligamentum nuchæ*), render upward curvature of the neck in the sagittal plane practically impossible. The head therefore enters the pelvis not in the sagittal but in an oblique plane.

4. **After Previous Replacement of a Fore-Limb.** An attempt may be made to correct true breast-head presentation in the same manner as in the cow by raising the head laterally. Owing to the deep situation of the head and the disproportionate length of the limbs the result in the mare is not always certain.

5. **With the Fœtus in the Dorsal Position.** Space for reaching the head deeply situated in the uterus may be obtained by rotating the fœtus from the upper to the lower position, either by means of a rod passed between the tied digits or by the use of a torsion fork. When considering the force to be exerted in rotation, the more delicate structure of the digital bones and the looser connection of the scapula to the thorax in foals must be borne in mind. For rotation to be successfully effected it is necessary that the skin of the fœtus shall glide smoothly on the uterine mucosa, and thus in protracted cases the lost amniotic fluid must be substituted and abdominal pressure eliminated by epidural anæsthesia. During turning the upward movement of the head must be carefully controlled. When the head and neck have been extended the fœtus is rotated back again into the dorsal position before extraction.

6. **With the Mare in the Dorsal Position.** In the mare, as in the cow, the space required for correction of breast head presentations is more readily obtained when the animal is placed in the dorsal position; in fact, in some cases effective reposition is impossible without so doing. In practice, however, the method is seldom employed, chiefly on account

of the danger associated with casting a heavily gravid mare, but also on account of the difficulties in effectively restraining the animal in this position. Again, there is a danger to the operator and his assistants. In all cases in which this position is considered in a mare already recumbent, the limbs must be effectively secured by proper hobbles. The use of improvised tackle for this purpose constitutes too great a danger to the operator and his assistants.

Delivery by Forced Traction with the Head Displaced (with or without Malposition of the Fore Limbs)

This is only to be considered in the mare when the head, in the nape posture, has advanced so far into the pelvis that the fœtal ears and occipital region are situated at the vulva, and, quite obviously, extension of the head is impossible. The author's personal experience confirms the observations of Tapken and Lecoq, that even in moderately well-developed foals delivery by traction with the head in this faulty posture is possible without injuring the genital passage provided that the dimensions of the maternal pelvis are normal. Even the spontaneous delivery of a fully developed foal in this position has been observed. The points of action for traction cords are on the fore limbs (if the carpus is flexed on the metacarpus) and the neck (the loop is passed between the neck and the head, the latter being flexed like a clasp-knife). The fœtus in such cases is generally dead.

Indications for Embryotomy. The first indication is removal of the head by amputation through the neck. The position for section of the neck, whether it is to be adjacent to the head or more towards the thorax, must be adapted to the requirements of individual cases. The wire embryotome or a wire saw with protective spirals is most suitable. The previous removal of a fore limb is seldom necessary.

C. Dorsal Flexion of the Head

Dorsal flexion of the head is much more rare in the foal than breast-head posture. This is apparently due in part to an anatomical feature, the length of the neck, and in part to the weight of the head. Tapken does not mention a case of this kind, whilst Harms, Franek, Albrecht, Lindhorst and others regard it as quite exceptional, even in the calf.

Fig. 99 illustrates the only case that the author has observed in his obstetric clinic. It might perhaps better be described as "lateral breast posture with dorsal displacement of the head."

THE COW AND MARE

Mechanism of Correction

In cases of true dorsal posture of the head the same or similar principles apply as in lateral displacement. Correction can never be effected

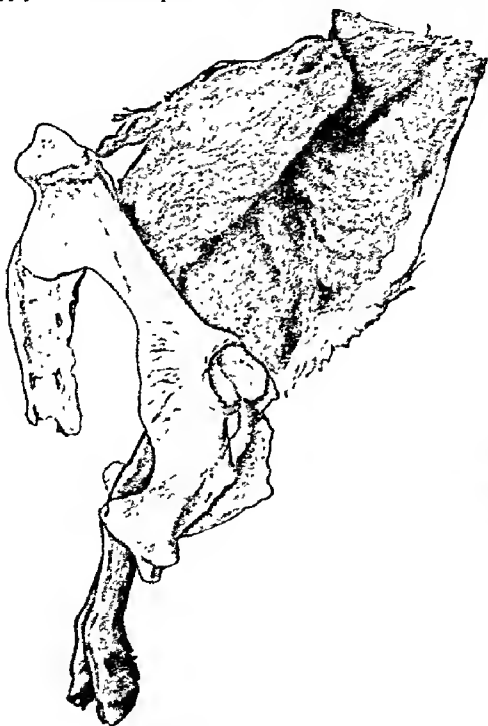


FIG. 99.—DORSAL POSTURE OF THE HEAD (INCOMPLETE).

by rotation in the sagittal plane, but only in the transverse plane after lateral rotation.

Indications for Embryotomy are also the same as for lateral posture of the head.

CHAPTER 17

DISPLACEMENTS OF THE FORE LIMBS

A. Carpal Flexion Posture

THIS may be unilateral or bilateral, and forms, especially in heifers, a serious obstruction to delivery. When the flexed limb, together with the head, is impacted in the pelvis, the term "engaged carpal flexion" is employed, and when the flexed limb is relatively movable in front of the pelvic inlet it is described as "disengaged carpal flexion."

THE COW

Mechanism of Correction

The main object of interference is to extend the limbs, because delivery of a full-term fœtus in this posture by forced traction can rarely be effected without injury to the genital passage.

Disengaged Carpal Flexion (Unilateral or Bilateral)

1. Using the Hand Alone (Fig. 100). The hand corresponding to the side of the displaced limb is introduced between the vaginal wall and the limb. After raising the flexed carpus against the side of the fœtal neck, the metacarpus is grasped on its outer aspect just above the fetlock joint. The limb is then lifted upwards by flexing the joints, especially the elbow and shoulder, to a maximum.

The position in which correction of the displaced limb is effected is thus in the uterus in front of the pelvis, for here sufficient space is available and the operation becomes simple. The main object in reposition, therefore, is to obtain complete flexion of all the joints to a degree that enables the fetlock joint to be raised over the border of the pubic bones. This is followed by extension of the metacarpus in the sagittal plane, the knee joint acting as the point of rotation.

2. Using the Hand and a Foot Snare acting as Antagonistic Forces. See p. 189.

3. Extraction with the Shoulder Joint Flexed. If the limb for some reason cannot be completely extended, an attempt should be made, before resorting to embryotomy, to extend the carpus forwards into the

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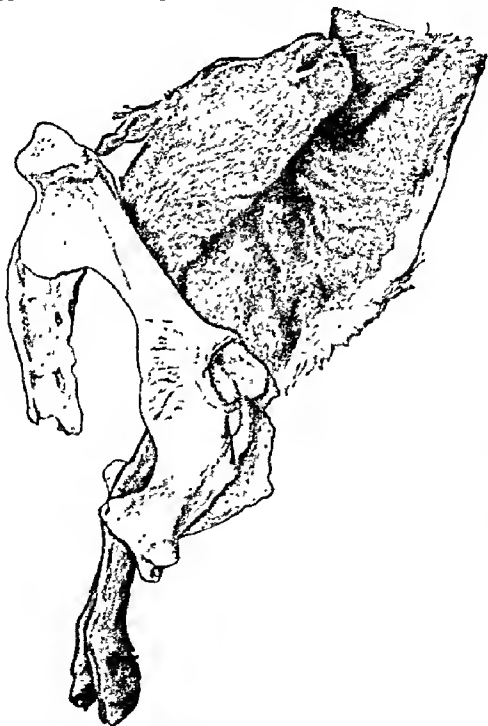


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2. Using the Hand and a Foot Snare acting as Antagonistic Forces. See p. 189.

3. Extraction with the Shoulder Joint Flexed. If the limb for some reason cannot be completely extended, an attempt should be made, before resorting to embryotomy, to extend the carpus forwards into the

uterus with the shoulder joint flexed to a maximum, on one or both sides, and subsequent delivery by forced traction. The prospects of successful delivery in this position are more favourable than in carpal flexion posture. Needless to say, success is more likely to be achieved in unilateral cases.

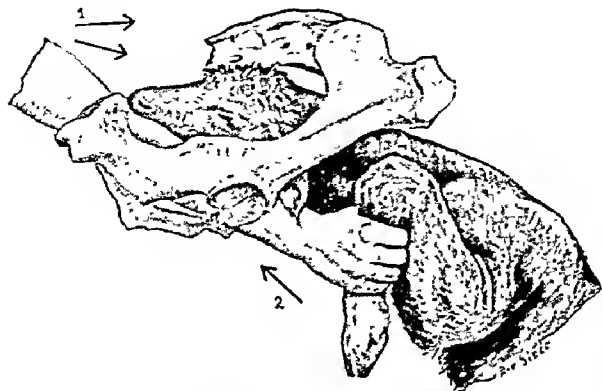


FIG. 100.—CORRECTION OF CARPAL FLEXION POSTURE.

After forcible displacement of the flexed limb in the cranio-dorsal direction, the digit can be raised over the pubic border into the pelvis without hindrance. The correct method of reposition.

Engaged (Impacted) Carpal Flexion (Unilateral or Bilateral)

The procedure adopted will depend, to a great degree, upon the extent to which the flexed knee and shoulder have entered the pelvis.

When it is obviously impossible, consequent upon the degree of impaction, to correct the malposition, attempts to do so are not only a waste of energy but may be dangerous. They only delay delivery. The condition may be dealt with as follows:

1. **By Forced Traction in the Engaged Posture.** If the foetus has already entered the pelvis so far that the chief obstacle appears to be overcome, delivery may be effected by careful traction on the head alone, or, when the condition is unilateral only, on the extended limb in addition. Before commencing traction, however, an attempt must be made to extend the shoulder and elbow, otherwise the humerus lies almost perpendicularly

in front of the pelvis. This is effected by applying strong pressure with the hand on the shoulder joint in the upward direction, at the same time slowly drawing the elbow over the pubic border by means of traction on a snare attached to the forearm (not on the metacarpus).

That delivery of the foetus with one or both carpi flexed can be effected without injury to the genital passage cannot be guaranteed. Injury may have already occurred before the assistance of the veterinarian is sought, and unfortunately it is impossible to prove this after delivery.

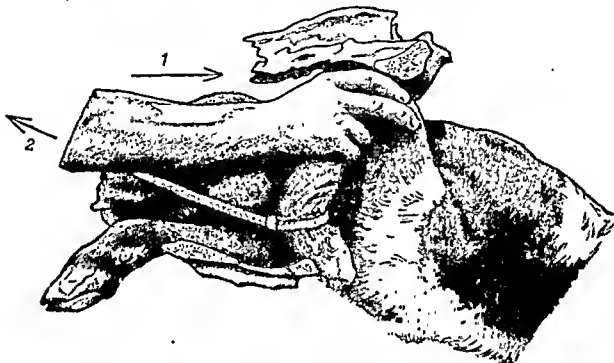


FIG. 101.—CORRECTION OF ENGAGED, UNILATERAL CARPAL FLEXION POSTURE BY THE ACTION OF OPPOSING FORCES (HAND AND FOOT SNARE).

In favourable cases the flexed carpal joint can be displaced in front of the pelvic inlet.

2. After Correction of the Abnormal Posture by the Use of the Hand and a Foot Snare acting as Antagonistic Forces (Fig. 101). This can only be successfully executed when the digit of the flexed limb lies in front of the pubic border. The extent to which the flexed carpus has entered the pelvis will indicate this. As a rule the hand alone is insufficient to apply the force necessary for correction, as there is insufficient space to grasp the metacarpus, and the hoof tends constantly to catch against the pelvic brim.

Extension can only be effected when, by pressure with the hand on the knee, the limb, forced upwards towards the shoulder and the thorax, is displaced from the pelvic inlet. Reposition is completed by traction on a foot snare attached either to the hoof or in the fetlock flexure. It is

best that the operator himself applies these antagonistic forces by working simultaneously with both hands, one acting in the vagina on the knee, and the other outside the vulva on the traction cord. By this means force is better regulated and controlled than when an assistant holds the cord.

3. After Correction of the Abnormal Posture, using the Crutch (Crutch Snare) and the Hand as Opposing Forces (Figs. 102 and 103). Before introducing the crutch into the vagina the loop is completed by threading the free end of the cord through the second "eye" of the fork. The loop, about the length of the metacarpus, is passed into the vagina on the lateral aspect of the limb and insinuated into the interdigital cleft. By tensing the cord the crutch is drawn forward and its fork is applied to the upper end of the metacarpus just below the knee.

Difficulty in applying the crutch snare due to lack of space may necessitate epidural anaesthesia. By ventral leverage on the handle of the crutch, the posterior border of the pelvic floor acting as the fulcrum, the knee is carefully displaced upwards and forwards towards the maternal vertebral column. When, by this means, the carpus has been so displaced that the long axis of the metacarpus forms an angle with the pelvic floor of 60-70 degrees, the foot can be guided into the pelvis by the hand without difficulty. To prevent bruising of the vaginal mucosa by the handle of the crutch during leverage, a piece of cloth folded several times is interposed between it and the ischium.

The tension on the snare passing from the fork to the interdigital cleft ensures that the crutch maintains a safe hold just below the knee, and at the same time it serves to draw the digit upwards towards the pelvis, as displacement of the carpus upwards and forwards proceeds. In addition, it acts as a second force in displacing the carpal joint upwards. Again, tension on the snare causes maximum flexion of the fetlock joint, and this greatly facilitates drawing the digit over the pelvic brim.

In cases in which impaction of the foetus in the pelvis prevents the application of the interdigital snare, reposition may be attempted using Kuhn's crutch in another manner (Figs. 104, 105).

The free end of the crutch cord is passed through the carpal flexure from its mesial to its lateral aspect, and then drawn out of the vulva again. The loop is completed by threading the free end of the cord through the second eye of the fork and the crutch advanced to a point immediately beneath the knee. The snare is then tightened forcibly and the cord secured to the crutch handle. By this means the fork is securely fixed. Again using the crutch as a lever, the knee may be forced along-

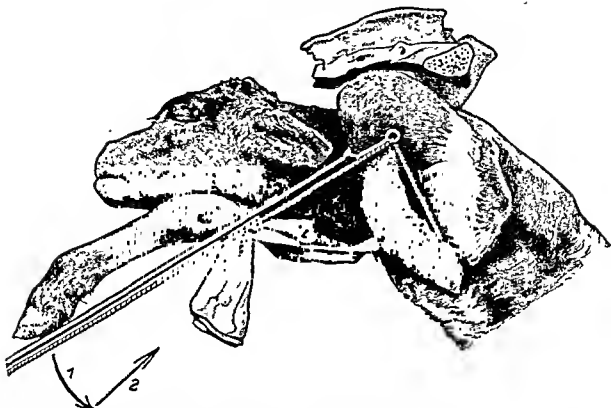


FIG. 102.—CORRECTION OF CARPAL FLEXION POSTURE, USING KÜHN'S CRUTCH.

Stage I.—After applying tension to the digit by means of the loop, the carpal joint is levered in the dorso-cranial direction towards the sacrum by forcible pressure applied to the crutch.

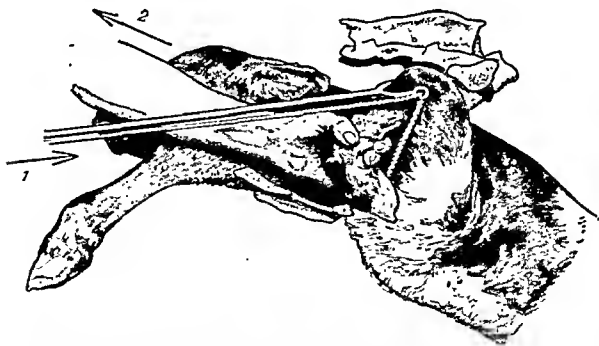


FIG. 103.—CORRECTION OF CARPAL FLEXION POSTURE, USING KÜHN'S CRUTCH.

Stage II.—Pressure on the crutch and tension on the snare have brought about flexion of the fetlock joint and at the same time the knee has been displaced to a maximum in the dorso-cranial direction. Final extension of the carpus is completed with the hand.

side the neck upwards towards the maternal sacrum. Bruising of the vaginal mucosa is again prevented by interposing a folded cloth between it and the crutch handle.



FIG. 104.—CORRECTION OF ENGAGED CARPAL FLEXION POSTURE, USING THE CRUTCH (WITHOUT AN INTERDIGITAL SNARE).

Stage 1.—The carpal joint is levered upwards to the lateral aspect of the neck. To avoid bruising a folded towel is placed on the ventral aspect of the vaginal outlet.

While the knee is kept at maximal upward displacement by continuous pressure on the crutch, the second hand draws the digit, with the fetlock strongly flexed, into the pelvis.

As the operation above described is generally rendered most difficult in consequence primarily of the absence of space in the pelvis and

secondly on account of the fact that the mother reacts by powerful straining at every change in the position of the foetal limbs and trunk, epidural anaesthesia becomes almost indispensable.



FIG. 105.—CORRECTION OF ENGAGED CARPAL FLEXION POSTURE.
Stage II.—The combined action of opposing forces after upwards displacement of the knee.

Indications for Embryotomy. Embryotomy is relatively simple. It generally comprises division of the limb or limbs at the flexed knee. Any of the modern embryotomy instruments may be used: the wire saw, the tubular or spiral-guarded wire embryotome, the chain saw, or the disarticulation knife. For introducing the saw a Lindhorst's guide-ring is advised. Having divided the limb, it is fixed for subsequent traction

by a snare. On the other hand, it may be decided, after replacing the flexed limb in the uterus, to sever it between the scapula and thorax (p. 297).

THE MARE

In the mare in cases of unilateral or bilateral disengaged carpal flexion posture there is generally sufficient space for correction, despite the length of the foetal limbs, especially when epidural anaesthesia is adopted.

Reposition is effected as follows:

1. *With the Hand Alone.* Correction is performed in fundamentally the same manner as in the cow.

2. *With the Hand and a Foot Snare.* In cases in which there is exceptionally powerful straining or in which the foetus is abnormally large, the use of a foot snare is indispensable. The snare is fixed at the fetlock, either by passing the loop over the end of the digit or by making the loop around the metacarpus and then sliding it down the limb. Whilst one hand applies pressure to the knee in the upward and forward direction until maximal flexion of the carpus, elbow and shoulder is obtained, the other, by gentle traction on the cord, guides the foot into the pelvis. Caution is necessary on account of the fetlock being extended.

If difficulty is experienced in passing the snare down the metacarpus to the fetlock, it may be facilitated as follows: After making the loop around the proximal end of the metacarpus, the knee is displaced upwards as far as possible. If simultaneous traction is applied to the cord, the snare tends to slide down the metacarpal bone, the latter being drawn at first into the perpendicular position and then obliquely backwards towards the pelvic brim. From this point the digit can be guided by hand into the pelvis with the fetlock flexed.

Finally, it may be decided to deliver the foal without correction of the carpal flexion. In this case, as was described in the calf, one or both limbs may be forced into the uterus under the foetal abdomen with the shoulder strongly flexed.

In engaged (impacted) carpal flexion posture in the foal one of the following methods may be adopted, according to the requirements of the individual case.

1. *Extension of the Limb with the Hand Only.* This is only possible when conditions as regards space are exceptionally good, such as a small foetus and a roomy pelvis.

2. **Extraction without Correction of the Faulty Posture.** Delivery by forced traction on the head and available parts of the fore limbs is the method to be preferred when the flexed knee (or knees) has already navigated the greater part of the pelvis. The tendency to obstruction is reduced by extending the shoulder joint. Strong pressure is applied to the shoulder whilst traction is exerted upon the flexed knee.

3. **Retropulsion of the Flexed Carpal Joint.** This is only a preliminary procedure to delivery by forced traction in the shoulder flexion posture, which is carried out by the method already described.

Indications for Embryotomy are the same as those applying in the cow.

B. Shoulder Flexion Posture

In this condition the head is extended and lies in the pelvis. One or both fore limbs are sharply flexed at the shoulder which is adjacent to the pelvic brim, whilst the remainder of the limb lies in the uterus in a state of extension under the foetal abdomen.

THE COW

Unilateral Shoulder Flexion

The possibility of delivering a living, un mutilated foetus is greater when the condition is unilateral only. Correction of the malposture may be performed as follows:

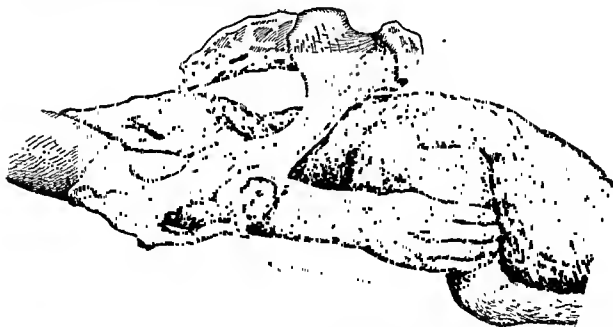


FIG. 106.—CORRECTION OF SHOULDER FLEXION POSTURE.

Provided conditions are favourable—the foetus is not too large and there is adequate space—extension of the fore limb lying in the shoulder flexion posture can be effected with the hand alone.

1. By Extension of the Limb with the Hand Only. The conditions essential for success, without applying antagonistic forces, are an early case, no impaction of the fœtus, a small head, and whenever possible the elimination of straining by epidural anæsthesia.

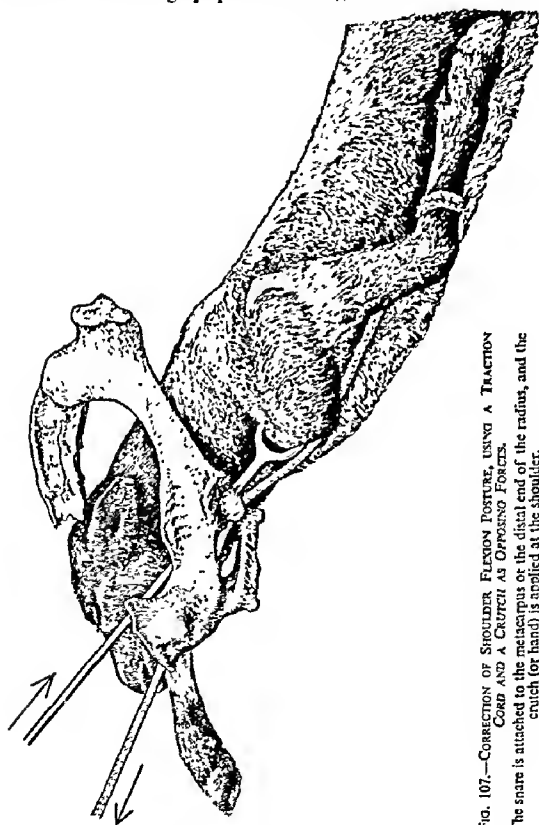


FIG. 107.—CORRECTION OF SHOULDER FLEXION POSTURE, USING A TRACTION CORD AND A CRUTCH AS OPPOSING FORCES.
The snare is attached to the metacarpus or the distal end of the radius, and the crutch (or hand) is applied at the shoulder.

The affected limb is gripped about the radius from the outer side (Fig. 106) and, by traction, drawn upwards towards the pelvis, into a state of carpal flexion. The latter is then overcome according to the methods described on p. 187.

2. By the Application of Opposing Forces—a Crutch (or Hand) and a Traction Cord (Figs. 107 and 108). With the aid of a snare introducer the cord is passed between the foetal elbow and trunk, and the loop completed. With the fingers the snare is pushed down the limb, over the

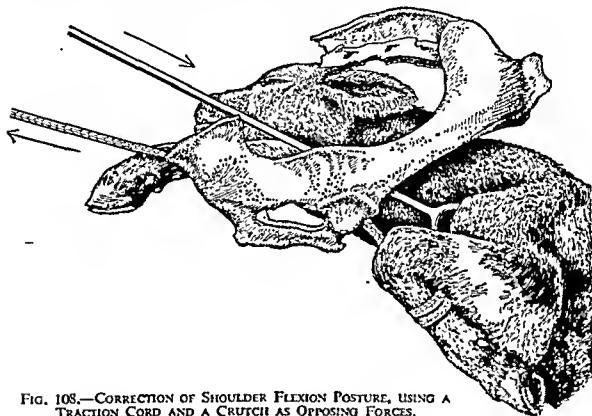


FIG. 108.—CORRECTION OF SHOULDER FLEXION POSTURE, USING A TRACTION CORD AND A CRUTCH AS OPPOSING FORCES.

knee, to the upper end of the metacarpus, where it is secured. By pressure on the shoulder joint, either by hand or with the crutch, the foetus is repelled into the uterus and held in that position. At the same time the assistant slowly pulls on the cord and so flexes the carpus, which approaches the pelvic brim in a state of carpal-flexion posture. The hand (or the crutch) may now be slipped down the humerus into the elbow flexure or it may remain where it is. Further correction is carried out according to the methods described on p. 189.

3. By Extension of the Limb, using Kühn's Crutch-Snare. This method is described on p. 202, when dealing with the correction of this posture

in the foal. The application of the instrument is the same in the calf. It is illustrated by Figs. 109, 110 and 111. The method is specially applicable in the cow when the presence of the foetal head in the pelvis

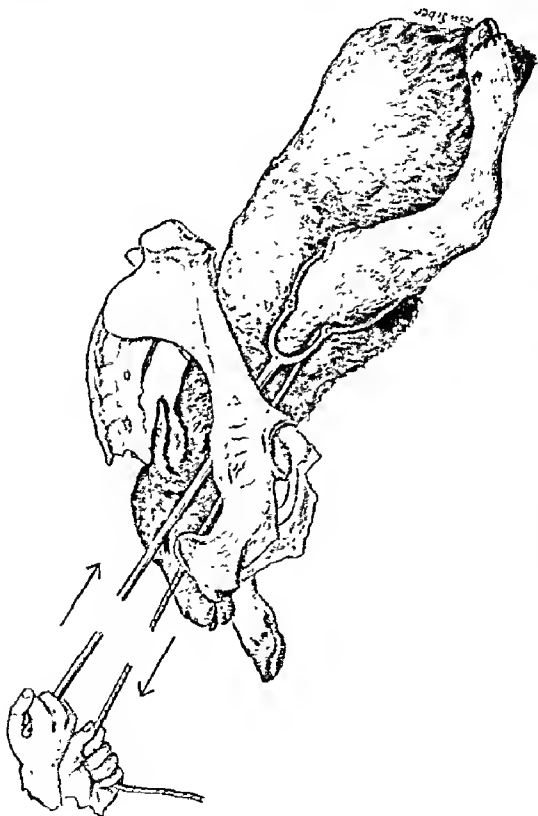


FIG. 109.—CORRECTION OF SHOULDER FLEXION POSTURE, USING A TRACTION CORD AND A CRUTCH AS OPPOSING FORCES.
The method of passing the snare from the elbow to below the knee.

prevents the arm being introduced far enough to grasp the limb. In order to prevent the snare slipping during traction, either over the knee

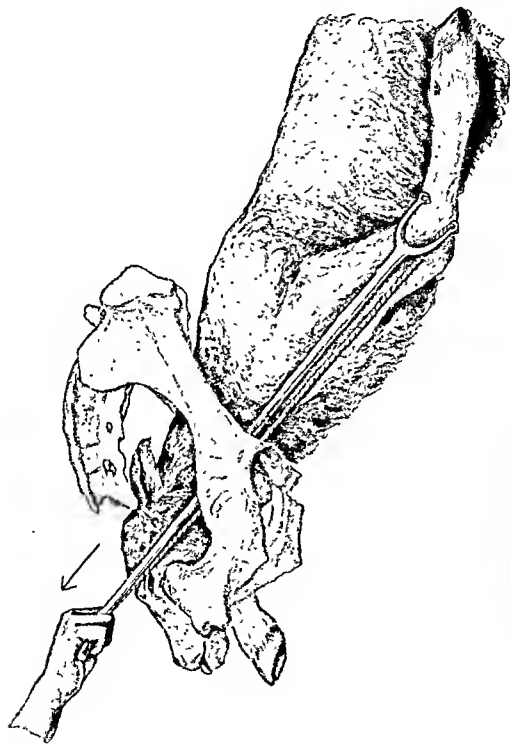


FIG. 110.—CORRECTION OF SHOULDER FLEXION POSTURE, USING KÜHN'S CRUTCH-SNARE.

The snare, having reached the appropriate position just below the knee with the fork on the outside, is tightened and fixed to the handle, ready for traction.

and up the radius or down the metacarpus, it must always be ensured that the fork lies on the outer aspect of the knee and that the snare is securely fixed immediately below the joint (Fig. 111).

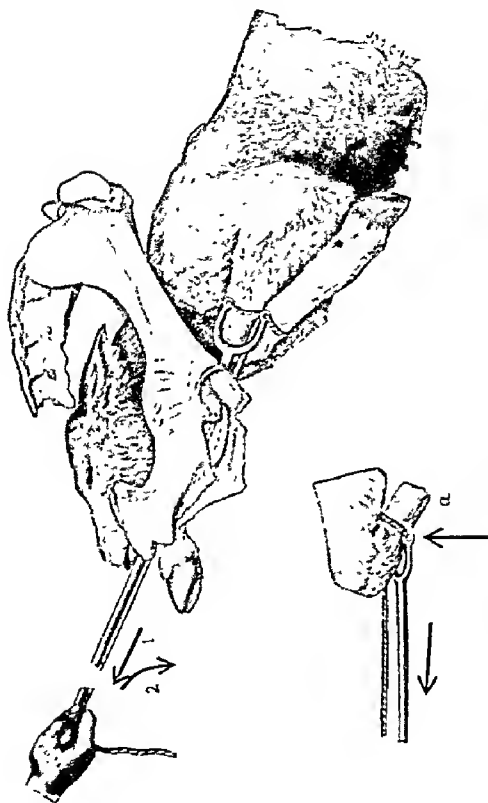


FIG. 111.—CORRECTION OF SHOULDER FLEXION POSTURE, USING KUHN'S CRUTCH-SNARE.

By traction on the crutch the posture becomes converted from shoulder flexion to that of disengaged carpal flexion. To correct the latter the crutch fork is rotated laterally and downwards until it assumes the position seen in small figure (a).

4. Delivery of the Fetus by Forced Traction with the Limb in the Shoulder-Flexion Posture. When the pelvis is sufficiently roomy and the fetus is not too large or the shoulder girdle strongly developed, forcible,

but not excessive, traction may be employed to effect delivery. It is important that there shall be successive and not simultaneous entry of the two shoulders into the pelvis. This may be brought about either by applying strong traction to the normally extended limb while the shoulder of the abnormal limb is repelled by a crutch, or by slow but forcible traction on the head, using blunt eye hooks (not a head snare), in the lateral direction towards the extended limb, the latter being held back in the vagina. In the second method it is the shoulder on the abnormal side which enters the pelvis first.

It is only after the shoulder and elbow joints of the abnormally placed limb have entered the pelvis that strong traction should be made on all parts.

Bilateral Shoulder Flexion.

Delivery may be effected as follows:

1. By Extension of One or Both Limbs, according to the rules laid down on p. 195.

2. By Forced Traction in the Faulty Position. If the fœtus is living, the point of action for traction is the orbital groove, using eye hooks. Passage of the shoulders through the pelvis is facilitated by alternating the direction of traction to the right and left and also by the plentiful infusion of linseed mucilage. This method, however, is not recommended, especially when the fœtus is living, because the excessive force which has to be exerted on the vertebral column generally causes its death. In addition, the mechanical conditions for delivery of the thorax are unfavourable, as it is impossible to ensure the successive and not simultaneous entry of the shoulders into the pelvis. The method, however, may be tried in an impacted case in which both shoulders have already entered the pelvis deeply, although a careful examination is necessary to ensure that this is the case.

Indications for Embryotomy: Unilateral Cases. The object of operation is separation of the affected limb at the thorax. The subcutaneous or the percutaneous method may be considered (see p. 297). The subcutaneous method, whilst slower, is generally more easy to perform. Removal of the normal (extended) limb is only necessary in special cases.

Bilateral Cases. As a rule it is sufficient to remove one limb only. If the head offers a serious obstacle to removal of the limb, it may be previously amputated. The employment of the rhachiophore or the vakufakt for the removal of the head is carried out in the same manner as in normal anterior presentation (pp. 303, 304).

THE MARE

The more roomy pelvis of the mare and the greater length of the head and neck of the foal render the correction of shoulder-flexion posture more favourable than in the cow. Delivery may be brought about either by correcting the abnormal posture on one or both sides or by forced traction in the faulty posture.

Mechanism of Correction

1. By the Hand Alone. The operation is the same as that described for the cow, but the greater length of the head and neck of the foal makes the limb much more difficult to grasp.

2. Using a Foot-Snare. As in the calf, the object is to fix the snare beneath the knee, but the latter joint is so deeply situated in the uterus that the application of the snare using the hand alone, is difficult or even impossible.

3. With Kühn's Crutch-Snare. This is the method to be preferred for the correction of shoulder-flexion posture in the foal. With the aid of a snare introducer the free end of the cord is passed between the humerus and the thorax from above-below, and drawn out of the vagina. The loop is completed by threading the end through the second eye of the fork. The crutch is then introduced and directed past the shoulder and elbow joints, along the lateral aspect of the radius and carpus, until the fork is adjacent to the outer aspect of the proximal end of the metacarpus. Continuous light traction on the snare-cord facilitates this.

Care must be taken that the fork of the crutch is not advanced beyond the proximal end of the metacarpus, for should it be attached to the middle or distal thirds of this bone the application of traction, instead of flexing the elbow joint and directing the carpus towards the pelvis, will act mainly on the carpus, flexing it dorsally but leaving the elbow unaltered. (Reference to Figs. 109 and 110 will serve to illustrate clearly this point.) The snare, passing around the limb to the fork, glides forward with the crutch until it is just below the knee. It thus acts firstly as a guide to the instrument and secondly, to secure it. When the operator is satisfied that the snare has passed as far as this point, he tightens it forcibly with the object of securing the fork lying directly on the lateral aspect of the joint (Fig. 110), and maintains tension on the cord with his hand.

When manual traction is now exerted on the crutch handle the elbow and carpus become flexed and the posture becomes one of carpal flexion.

The degree of traction required is not great. If the fork, still lying on the outer aspect of the carpus, is then rotated through an angle of 90 degrees, laterally and ventrally and slightly withdrawn, it occupies the position appropriate for the correction of carpal-flexion posture (Fig. 104). An important feature of the final straightening of the limb is the almost automatic flexing of the digit at the fetlock as the shoulder and elbow are levered upwards.

Forced Traction in the Faulty Posture. This method may be considered when attempts at correction have failed. It is relatively more likely to be successful in the mare than in the cow. The mare's pelvis should be raised sufficiently and the foetal skin well lubricated. Even in the mare it is improbable that a full-term foetus will be delivered alive owing to the danger of injury to the vertebral column or spinal cord during extraction.

Indications for Embryotomy. The same principles apply as in the calf. In bilateral cases one of the abnormally situated fore limbs is removed percutaneously, separating the scapula from the thorax, and the foetus delivered by traction without attempting to correct the other fore limb. If the condition is unilateral only, the normal limb is removed subcutaneously or percutaneously and the foetus again delivered without correction of the other limb. The use of the rhachiophore or vakufakt is not generally necessary in foals.

C. Shoulder-Elbow Flexion Posture

Diagnostic Indications

The face is protruding from the vulva and the fore digits, lying under the jaw, are just visible. The shoulder joint lies in front of the elbow. The former has entered the pelvis, whilst the latter is impacted at the pelvic brim. The condition is generally bilateral. In physiological delivery the fore limbs enter the pelvic canal in an oblique plane with all joints extended to a maximum, with the result that the digits precede the nose. The latter lies about the middle of the metacarpus. When the normal mechanism is disturbed, such as premature traction on the head in lay interference or an atonic condition of the uterus, natural adaptation cannot take place and shoulder-elbow flexion posture results. The abnormality is, however, comparatively rare both in the mare and cow.

Correction in the Cow and Mare

The essential point is to overcome the impaction of the elbows at the pelvic brim. This is effected by slight retropulsion of the foetus, either with

THE MARE

The more roomy pelvis of the mare and the greater length of the head and neck of the foal render the correction of shoulder-flexion posture more favourable than in the cow. Delivery may be brought about either by correcting the abnormal posture on one or both sides or by forced traction in the faulty posture.

Mechanism of Correction

1. By the Hand Alone. The operation is the same as that described for the cow, but the greater length of the head and neck of the foal makes the limb much more difficult to grasp.

2. Using a Foot-Snare. As in the calf, the object is to fix the snare beneath the knee, but the latter joint is so deeply situated in the uterus that the application of the snare using the hand alone, is difficult or even impossible.

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When manual traction is now exerted on the crutch handle the elbow and carpus become flexed and the posture becomes one of carpal flexion.

assistance is forthcoming there is a danger that the digits may become impacted in the dorsal vault of the vagina, possibly rupturing it and even penetrating the rectum.

Mechanism of Correction

This, as a rule, is more easily effected in the mare than in the cow, on account of spacial conditions being more favourable, provided, of course, that the vaginal wall has not already been ruptured. Both extremities must be forced into a position lateral to the nape and kept

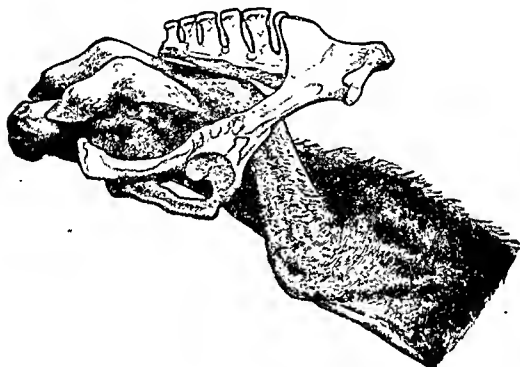


FIG. 112.—FOOT-NAPE POSTURE (BILATERAL).

The special danger of this posture, whether unilateral or bilateral, is that the digit, being forced against the vaginal roof during straining, causes a cup-shaped depression, which, unless quickly relieved, may result in rupture and penetration.

there. This is effected by attaching a snare to each fetlock and exerting strong traction downwards and outwards. Two assistants are required. In order to obtain the necessary space for the correction of the position of the limbs, the head must be repelled and at the same time raised by the hand until the limbs are in the extended posture beneath the head (Fig. 113). If the digits have perforated the vagina and possibly the rectum, an attempt should still, as a rule, be made to effect delivery, but it is necessary to withdraw the digits from the rupture before correcting the posture. This is greatly facilitated by overcoming straining

the hand pressed against the face or by pressure by a hand or crutch against the shoulder joint, and the application of traction on the limbs one after the other. If a crutch is used, a safe "foothold" can be obtained between the shoulder and the chest.

Embryotomy is seldom required, but it may be necessary in the case of an exceptionally large fetus. It is performed in accordance with the principles outlined on p. 149.

D. Foot-Nape Posture

This comprises displacement of one or both fore limbs upwards, until they lie on top of the extended head in the vagina.

THE COW

Owing to the relatively short limbs and the powerful muscular attachment of the scapula to the thorax, this form of malposition is rare, and when it does occur is generally unilateral. There is always associated with it considerable danger of rupture of the vaginal roof.

Mechanism of Correction and Delivery

It is absolutely essential that the faulty posture shall be corrected before applying traction. The displaced fetlock is grasped and forced outwards and downwards, whilst the other hand, placed under the jaw, lifts and at the same time repels the head until it lies in the dorsal section of the pelvic cavity or in front of the pelvic inlet.

Extraction in the faulty posture can only be effected in very exceptional cases, and even then excessive force must be avoided.

Indications for Embryotomy. Remarks based on experiences in the cow are inadequate for generalization. Operative measures must be adapted to individual cases, having regard to considerations of space and the position of the limbs.

THE MARE

The length of the limb and the loose connection of the scapula on the one hand, and the forceful straining of the mother on the other, often lead to a delay in accommodation, with the result that the head does not enter the pelvis until the extension of the limbs has taken place, and the digits have advanced to a certain extent towards the roof of the pelvis. As a rule both limbs are involved, and they may even be crossed over the nape of the neck, as in Fig. 112. Unless timely and well-directed

assistance is forthcoming there is a danger that the digits may become impacted in the dorsal vault of the vagina, possibly rupturing it and even penetrating the rectum.

Mechanism of Correction

This, as a rule, is more easily effected in the mare than in the cow, on account of spacial conditions being more favourable, provided, of course, that the vaginal wall has not already been ruptured. Both extremities must be forced into a position lateral to the nape and kept

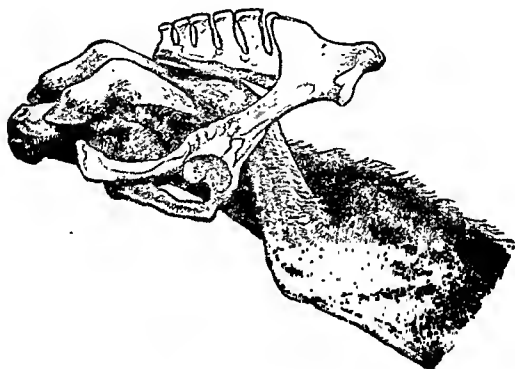


FIG. 112.—FOOT-NAPE POSTURE (BILATERAL).

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there. This is effected by attaching a snare to each fetlock and exerting strong traction downwards and outwards. Two assistants are required. In order to obtain the necessary space for the correction of the position of the limbs, the head must be repelled and at the same time raised by the hand until the limbs are in the extended posture beneath the head (Fig. 113). If the digits have perforated the vagina and possibly the rectum, an attempt should still, as a rule, be made to effect delivery, but it is necessary to withdraw the digits from the rupture before correcting the posture. This is greatly facilitated by overcoming straining

by the employment of epidural anæsthesia and also by copious infusion of linseed mucilage.

Indications for Embryotomy. In the mare also the individual case must be carefully considered and the most appropriate interference performed. If the head presents a serious obstacle to correction of the limbs, it should be amputated (p. 274). When the application of the wire saw to the neck is impossible and the shoulder blade of one limb is more easily reached, the latter should be removed percutaneously (p. 280), after which correction of the second limb and delivery of the fœtus can be completed. In cases in which the vagina is ruptured, amputation of

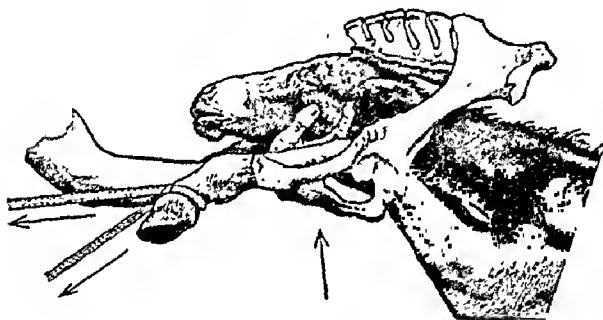


FIG. 113.—CORRECTION OF BILATERAL FOOT-NAPE POSTURE.

While the operator presses the head against the pelvic roof two assistants exert ventro-lateral traction on the limbs.

the involved limb at the shoulder, and not through the radius or metacarpus, should be attempted, otherwise the stump may constitute a dangerous obstacle during delivery. If, however, amputation at the carpal joint with a wire saw can be effected, this consideration does not hold, as a snare can be applied immediately above it.

When, in a case of rupture of the vagina and rectum, the fœtus is so far advanced in the pelvis that the embryotome cannot be applied, the maternal perineum should be incised rather than subjecting it to tearing by forcible traction on the fœtus. The wound is subsequently sutured after delivery.

CHAPTER 18

DISPLACEMENTS OF THE HIND LIMBS IN POSTERIOR, DORSAL PRESENTATION

General Considerations

OWING to the smaller percentage of cases of posterior presentation than anterior, in both the cow and the mare, the number of faulty hind-limb postures is correspondingly less. When, however, they occur and the case is protracted, the conditions for correction are often less favourable than in anterior presentation, because extension of a hind limb, owing to its length, requires considerably more space. This is especially the case in the mare.

A. Hock-Flexion Posture (Unilateral or Bilateral)

The fœtus is presented with one or both flexed tarsal joints at the pelvic inlet. In protracted cases in which the hock has become impacted more or less deeply in the pelvis, the term "engaged hock-flexion posture" is applied, and in recent cases in which it lies more or less freely in front of or below the os pubis, "disengaged hock-flexion posture." An insufficient number of observations has been made to state positively the relative frequency of unilateral as compared with bilateral cases, but the author's experience has been that bilateral displacement is the more common both in the cow and in the mare.

THE COW

Methods of Correction

Any attempt to deliver by forced traction a normally developed, full-term calf presented in either unilateral or bilateral hock-flexion posture, can only be described as unscientific. The only points for the application of traction are the flexure of the hock or the distal end of the tibia. By applying traction here the angles formed by the flexed hip and stifle joints become opened. This is automatically accompanied by opening of the angle of the hock joint, and the stronger the traction applied the more forcibly is the tuberosity of the os calcis jammed against the pelvic roof, possibly resulting in impaction of the digit in the pelvis. The conditions necessary to effect delivery are, therefore, (1) complete extension

of the limb or limbs, or (2) maximal flexion of the hip, the remaining joints being extended, and subsequent delivery by forced traction (breech presentation). Correction of this posture is usually easier in the cow than in the mare, because in the former, on account of the limb bones being shorter, the digit can be more readily reached with the hand.

1. *Using the Hand Alone.* The limb is grasped by the metatarsus, and by exerting maximal displacement of the hock in the forward and upward direction, sufficient space is acquired to draw the digit into the pelvis. It is advisable to employ the hand corresponding to the side of the displaced limb, and in each case working from the outside towards the mid-line, and not the reverse. The method can only succeed when, firstly, it is possible to introduce the hand sufficiently far to grasp the distal end of the metatarsus; and, secondly, the operator possesses sufficient strength to perform the threefold operation of raising the foot, displacing the limb with all joints flexed, and drawing the digit over the pelvic brim almost simultaneously. As a rule it is only possible in recent disengaged cases in which there is ample mobility of the fetus, and not in protracted cases in which the hocks are impacted. The operation is greatly facilitated, and sometimes is only possible, by the adoption of epidural anaesthesia, and in such there should be no delay in its application. By its use the operator is able to change the position of his hand without losing the degree of correction he has already attained, due to forceful straining.

2. *Using the Hand and Foot-Snare combined as Opposing Forces* (Figs. 114 and 115). Jöhnk recommends a foot snare with an interdigital loop, applied either from below over the hoof or from above the fetlock and downwards. By traction on the cord the fetlock and pastern joints become flexed to a maximum and the digit drawn towards the pelvic brim. By repelling the hock upwards and forwards by pressure with the hand, traction on the cord serves to draw the hoof into the pelvis. It will thus be seen that the axis of rotation lies in the hock joint, and the radius is represented by the length of the metatarsus without the phalanges.

This method can only be successful in cases in which there is ample space in front of the pelvis and in which the hock joint is freely movable. When the joint is engaged in the pelvis Jöhnk's snare alone does not function, because the digit is fixed in front of and below the pubic brim and the length of the metatarsus necessitates considerably more space for its correction than is available in the pelvic cavity. In this case correction of the posture can only be brought about by grasping the fetlock joint and pressing it upwards and forwards as far as possible away from

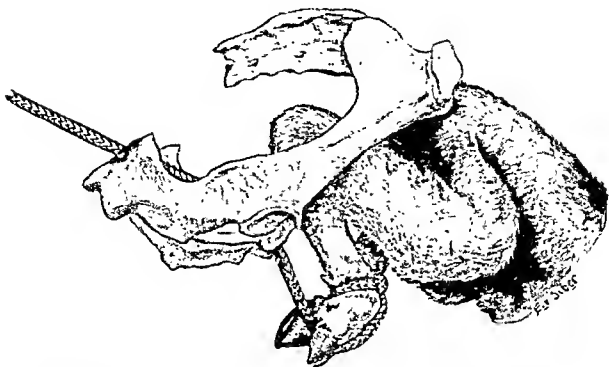


FIG. 114.—BILATERAL ENGAGED HOCK-FLEXION POSTURE: JÖHNK'S SNARE APPLIED TO THE RIGHT DIGIT.



FIG. 115.—CORRECTION OF HOCK-FLEXION POSTURE, USING THE HAND AND JÖHNK'S SNARE. Opposing forces: Pressure against the hock joint, forwards and upwards, and traction on the snare passed through the interdigital cleft.

the pelvic inlet, while the digit, through the medium of the foot snare, is guided into the pelvis with the other hand. In this way the space required for rotation is obtained in front of the pelvic inlet. The point of rotation in this case is about the centre of the metacarpus, so that the radius of rotation is reduced to a minimum for the space available.

3. Using the Crutch and a Hand as Opposing Forces. See p. 213 and Figs. 118 and 119, dealing with the correction of this posture in the foal.

4. Using the Crutch Alone (Figs. 116 and 117). The snare is completed by passing the free end of the cord through the second eye of the fork. A loop about the same length as the metatarsus is carried into the uterus and inserted in the interdigital cleft of the limb to be corrected, while the fork is placed against the plantar aspect of the os calcis with the prongs directed forward and upward. Before commencing the operation of reposition the operator must ensure that the anterior branch of the interdigital loop passes over the middle of the anterior aspect of the flexed fetlock joint, and not to one side, otherwise the loop may slip upwards and off the digit during traction.

The operation of correction is now commenced. By exerting gradually increasing pressure on the os calcis in the direction of the foetal rump, at the same time maintaining tension on the interdigital cord, the hock joint becomes at first flexed to a maximum, and afterwards progressively extended, with the movement of the digit towards the pelvis. Thus by simple forcible pressure with the crutch against the hock, the distal end of the limb undergoes the required rotation in the sagittal plane, so to speak, automatically. Not until the last stage, when the flexed digit lies directly in front of the pubic border, is the hand used to guide it into the pelvic canal.

The process of movement in the hind limb described above can be explained quite clearly on mechanical principles. The limb from the point of the os calcis to the digit represents an unequal armed lever with its fulcrum at the tibio-tarsal articulation, the short arm being represented by the tuberosity of the os calcis and the long arm by the metatarsus. Through the medium of the tendo Achillis the short arm of the lever is connected with the skeletal parts lying towards the rump. Every change of position of the hock joint in the direction of the ischial tuberosity of the foetus (i.e. forwards and upwards) brings about an action of extension of the hip and stifle, although only to a slight degree, and therefore a shortening of the tendo Achillis. The result becomes a slight opening of the angle of the hock joint, together with a rotation into the perpendicular position of the metatarsus and digit. When the pressure,

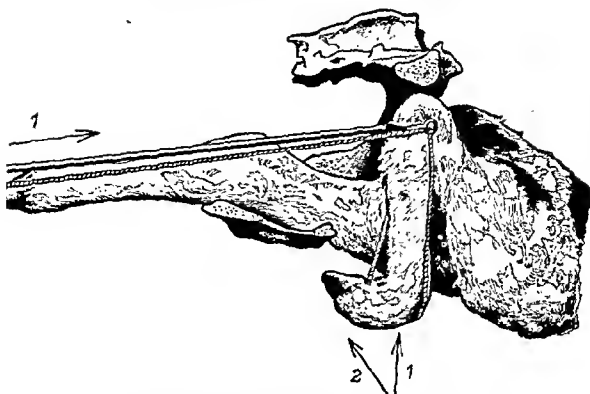


FIG. 116.—CORRECTION OF HOCK-FLEXION POSTURE, USING THE CRUTCH-SNARE.
Stage I.—Opposing forces: Pressure by the crutch on the hock joint and traction on the digit by the interdigital snare.

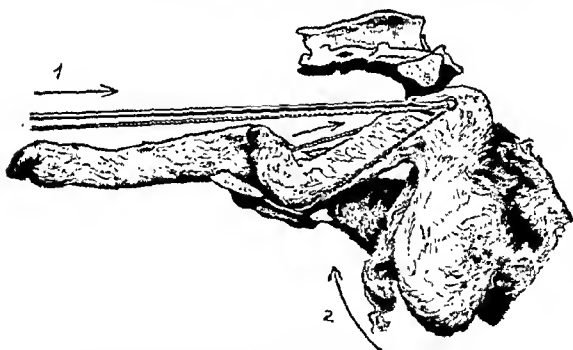


FIG. 117.—CORRECTION OF HOCK-FLEXION POSTURE, USING THE CRUTCH-SNARE.
Stage II.—After forcible pressure on the crutch in the upward and forward direction, traction on the cord serves to extend the hock and direct the digit, with the fetlock and pastern flexed, into the pelvis. If necessary, this latter movement can be assisted by hand.

however, acts not immediately on the tibio-tarsal articulation but slightly above it, the excursion of the long arm of the lever—that is, the extremity end—occurs in the opposite direction and therefore towards the pelvis. Finally, when force is exerted on the long arm of the lever (the fetlock joint) simultaneously with pressure on the short arm (the os calcis), an action is produced which brings about maximal flexion of the phalanges and at the same time elevation of the extremity, and thus a movement of the distal end of the metatarsus in the direction of the pelvis must follow. When the interdigital snare passing down from the crutch fork is applied in the manner previously described, the process of movement is actually carried out by dividing the force between the arms of the lever in the form of pressure on the short arm, with simultaneous and equal traction on the long one.

Delivery of the fetus is finally brought about by correcting the hip-stifle flexion, followed by forcible traction.

Indications for Embryotomy. These are the same as in the mare (p. 215).

THE MARE

In the mare also the rule applies that all methods available for correction of hock-flexion posture must be attempted, for despite the more favourable anatomical conditions, the prospects of delivering the fetus in the faulty posture without injury to the mother are as unfavourable as in the cow. If delivery is to be effected by forced traction, it can only be performed after extension of the hip and stifle joints together with simultaneous maximal flexion of the hock. (This would appear to be extremely difficult in view of the antagonistic actions of the gastrocnemius and flexor metatarsi muscles.—J. G. W.) Albrecht describes the operation as follows: A snare is applied either in the hock flexure or to the distal end of the tibia. Traction is applied while the fetus is at the same time repelled downwards and forward by the hand pressing against the ischial tuberosities. In the author's experience the method can occasionally be successfully carried out in a premature case, but not with a full-term fetus.

Correction of hock flexion posture is much more difficult in the foal than in the calf, on account of the greater length of the limb bones and the much more forceful straining of the mare.

The following method may be employed:

1. Using the Hand Aloie. The distal end of the metatarsus is grasped from its lateral aspect. An essential condition for successful reposition

by this means is sufficient space in front of the pelvic inlet. This is only available in exceptional cases, and as a rule the strength of the arm alone is insufficient to displace the hock forwards and upwards for a sufficient distance to enable the digit to be drawn into the pelvis. It continually becomes arrested in front of the os pubis. Thus in most cases the application of opposing forces becomes necessary. It may be possible in favourable cases to effect this by using both hands, one applied to the tuberosity of the os calcis and the other to the flexed digital joints.

2. Using the Crutch and a Hand as Opposing Forces (Figs. 118 and 119). The passage of the free end of the crutch cord around the hock flexure is facilitated by the use of a guide (Lindhorst's ring). That the crutch fork is applied to the correct point on the hock must be ascertained by hand. It must be fixed as high up the os calcis as possible, and not adjacent to the upper end of the metatarsus. To ensure this, it may be necessary to loosen the loop in the flexure. In this way pressure applied to the crutch, acting on the proximal end of the lever formed by the tibio-tarsal articulation, influences the metatarsus and digit in the opposite direction. While the fork is fixed in the appropriate position by the operator's hand, the snare is tightened by an assistant, who winds the cord several times around the handle to prevent loosening during operation. (With practice the operator can manage this himself with his other hand.) The necessary requirements for effecting reposition with the crutch are now fulfilled—viz. the fork is fixed as high as possible beneath the summit of the os calcis and its fixation is absolutely secure. The construction of the fork is such that it not only grips the hock, but also acts as a hinge, so that regulation of the plane in which the digit must rotate can be governed at will.

The actual operation of reposition is now performed. The handle of the instrument is lowered, and by exerting gradually increasing pressure the hock joint is displaced upwards and forwards away from the pelvis until the metatarsus occupies an oblique downward and backward direction towards the pelvis. The hand is now passed into the vagina, under the crutch, and by gripping the fetlock the digit can be guided into the pelvis.

This method of correcting hock-flexion posture by the use of Kühn's crutch, whether the condition is unilateral or bilateral, is such an ideal one that even in protracted cases, in which there is impaction of the hock in the pelvis, reposition can be effected without recourse to epidural anaesthesia. The latter, however, is indicated in cases in which there is marked swelling of the vaginal wall or in which the whole genital passage is dry.

however, acts not immediately on the tibio-tarsal articulation but slightly above it, the excursion of the long arm of the lever—that is, the extremity end—occurs in the opposite direction and therefore towards the pelvis. Finally, when force is exerted on the long arm of the lever (the fetlock joint) simultaneously with pressure on the short arm (the os calcis), an action is produced which brings about maximal flexion of the phalanges and at the same time elevation of the extremity, and thus a movement of the distal end of the metatarsus in the direction of the pelvis must follow. When the interdigital snare passing down from the crutch fork is applied in the manner previously described, the process of movement is actually carried out by dividing the force between the arms of the lever in the form of pressure on the short arm, with simultaneous and equal traction on the long one.

Delivery of the fœtus is finally brought about by correcting the hip-stifle flexion, followed by forcible traction.

Indications for Embryotomy. These are the same as in the mare (p. 215).

THE MARE

In the mare also the rule applies that all methods available for correction of hock-flexion posture must be attempted, for despite the more favourable anatomical conditions, the prospects of delivering the fœtus in the faulty posture without injury to the mother are as unfavourable as in the cow. If delivery is to be effected by forced traction, it can only be performed after extension of the hip and stifle joints together with simultaneous maximal flexion of the hock. (This would appear to be extremely difficult in view of the antagonistic actions of the gastrocnemius and flexor metatarsi muscles.—J. G. W.) Albrecht describes the operation as follows: A snare is applied either in the hock flexure or to the distal end of the tibia. Traction is applied while the fœtus is at the same time repelled downwards and forward by the hand pressing against the ischial tuberosities. In the author's experience the method can occasionally be successfully carried out in a premature case, but not with a full-term fœtus.

Correction of hock-flexion posture is much more difficult in the foal than in the calf, on account of the greater length of the limb bones and the much more forceful straining of the mare.

The following methods may be employed:

1. **Using the Hand Alone.** The distal end of the metatarsus is grasped from its lateral aspect. An essential condition for successful reposition

shoulder and held with his other hand, and the digit drawn into the pelvis at the appropriate moment.

3. **After Conversion into Hip-Flexion Posture.** The last method for consideration is the delivery of the foetus by traction in the hip-flexion posture after displacement of the limb or limbs forwards into the uterus under the foetal abdomen. This should only be attempted when the hocks are so deeply placed that they can only be reached, if at all, with great difficulty, and all attempts to draw them nearer the pelvis fail (see following section).

Indications for Embryotomy. The method which immediately suggests itself is division of the limb or limbs at the hock joint. This can be performed either with a Pflanz's embryotome or with a steel wire saw (tubular or spiral guard, p. 300). Owing to its adaptability to all angles, especially in cases of ankylosis and tendon contraction, the wire saw is the more useful. The amputation knife and the chain saw are not suitable because of their liability to become fixed in the bone. Division must always be made below the tuberosity of the os calcis, for the latter serves to secure the snare which is required for subsequent traction.

By conversion of the posture into that of hip flexion, amputation through the hip joint may be rendered possible (p. 301).

In acute-angled impaction of one or both hock joints in the mare, it is sometimes sufficient to sever the gastrocnemius tendon with a finger knife, and thus by overcoming the antagonism of this muscle to the flexor metatarsi (peroneus tertius), delivery in the faulty posture becomes possible. The traction cord is applied to the tibia and not to the hock flexure.

B. Hip-Flexion Posture (Breech Presentation)

This is constituted by complete flexion of one or both hip joints, with more or less complete extension of the other joints of the limb. In bilateral cases the term "true breech presentation" is generally applied.

The conditions responsible for the production of this abnormality probably explain why the condition is much more often bilateral than unilateral, and also why it is much less frequently encountered in the mare than in the cow. Again, there is a difference in the nature of breech presentation in the solipeds as compared with the ruminants. In the foal the dorsal aspect of the os sacrum and the posterior part of the lumbar vertebral column are well flexed and directed towards the pelvis, whilst the buttocks, including the anus and tail, are below the pelvic brim. In

In the absence of a crutch it may be possible to apply the opposing forces necessary for correction by means of the hand grasping the tuberosity of the os calcis and a snare attached below the fetlock joint. The traction cord of the latter should be passed over the operator's

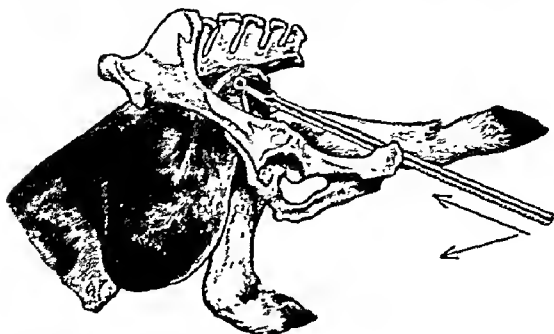


FIG. 118.—CORRECTION OF HOCK-FLEXION POSTURE IN THE FOAL, USING THE HAND AND KÜHN'S CRUTCH—OPPOSING FORCES.

Stage I.—By pressure with the crutch the hock joint and the body of the fetus are displaced ventrally.



FIG. 119.—CORRECTION OF HOCK-FLEXION POSTURE.

Stage II.—After maximal displacement of the hock joint, the digit is grasped and drawn into the pelvis.

2. With Kühn's Crutch-Snare. For the technique of procedure see p. 227, dealing with the foal; and Figs. 127, 128 and 129.

In cases in which there is difficulty in sliding the snare down the limb until it lies below the hock joint, correction of the posture can still be effected in the following way (see Figs. 120 and 121): With the aid of a snare introducer the loop is formed around the femur and pushed down to the lower end of the tibia. The crutch is introduced and the fork guided by hand to a position above the posterior aspect of the hock. The loop, which has been held loosely up to this point, is now tightened

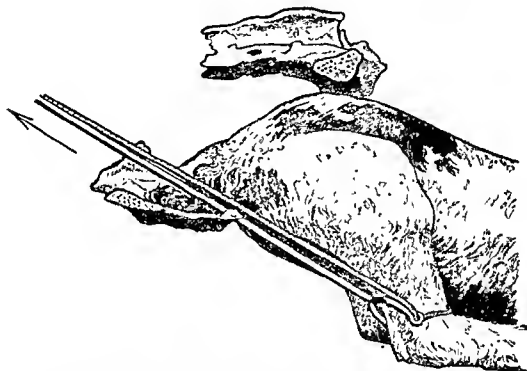


FIG. 120.—CORRECTION OF HIP-FLEXION POSTURE, USING A CRUTCH.

Stage I.—Having advanced the loop as far as the hock, the fork is placed transversely just above the back of the joint, and the snare tightened.

and the cord secured to the crutch handle, so that no slipping of the fork can occur. By slow forcible traction on the crutch a state of hock-flexion posture is produced. For the correction of this the snare is loosened to enable the flexed hock to be drawn over the border of the os pubis into the pelvic inlet. The fork is then guided under the plantar aspect of the hock and the snare again tightened. From this point the procedure is the same as described on p. 213. When the case is a difficult one, placing the cow in the dorsal position considerably facilitates bringing the limb into a state of hock flexion. Once this is attained further correction is performed with the cow in the ventral position.

the calf this arching of the back does not occur, and the buttocks, with the tail, are presented at the pelvic inlet.

When examining the reasons for the greater degree of flexion of the lumbar region in breech presentation in the foal, the following have to be considered: The greater inclination of the pelvis towards the lumbar vertebrae in the mare; the less powerful development of the musculature of the croup and loins; the lesser degree of tension in the ligaments and muscles; and, finally, the greater length of the limbs in the foal. The longer the extremities, the greater is the pressure in the ventral direction on the hips, and thus, when the limbs are displaced under the body, there is marked flexion of the lumbar region.

General Remarks regarding Treatment

In contrast to hock-flexion posture, delivery of the fœtus by forced traction in unilateral or bilateral hip-flexion posture may be indicated, especially when the fœtus is not abnormally large. The more correct the technique, the more likely is it to be successful, and as a rule the result is favourable, at any rate as regards the mother.

When deciding whether delivery by traction in the abnormal posture is to be preferred to attempts at correction, it should be remembered that in breech presentation the life of the fœtus is already seriously endangered, and this danger will be greatly increased when delivery has to be effected under such difficult conditions as exist in the hip-flexion posture, which considerably prolong the duration of parturition.

At the same time, on principle, attempts should be made at correction of the posture first, at least when the fœtus is living.

THE COW

Mechanism of Correction and Delivery

1. **Correction of Posture, using the Hand Alone, in Unilateral or Bilateral Cases.** Using the hand corresponding to the displaced side, the tibia is grasped, from its lateral aspect, as near to the hock as possible. Flexion of the hock and stifle is effected by applying slow but forcible traction in the mesial and upward directions, towards the pelvis. When the distal end of the tibia cannot be reached by hand, the crutch should be used to facilitate the fixation of a snare just above the hock. Having effected hock and stifle flexion, the posture becomes that of hock flexion. This is corrected according to the rules already described. It is hopeless to attempt reposition with the hand alone, either when the stifle only can be reached or when the hand continually slips off the tibia.

quite insufficient. Not only is it liable to be torn off, but its situation is so high that traction upon it does not serve to raise the fœtal buttocks into the maternal pelvis. A more effective procedure is to use a specially designed snare.

One of the best is Saake's snare (also known as the abdominal snare, Fig. 122). Its application is as follows: First, with a Schriever's snare introducer fixed to the "eye" loop of the cord, the latter is passed from above, between the stifle joint and the flank on one side, and then drawn

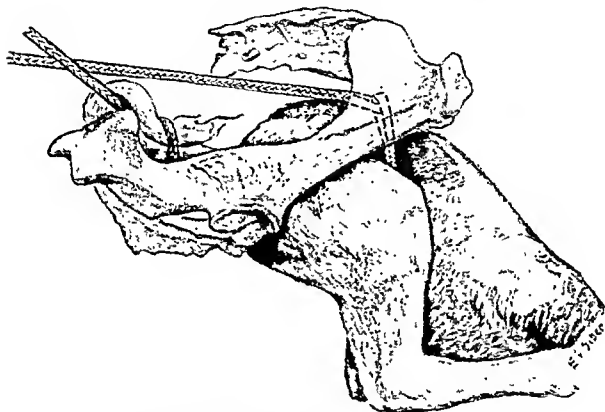


FIG. 122.—HIP-FLEXION POSTURE—THE USE OF SAAKE'S SNARE.

The eccentric line of traction, acting on the lumbar vertebrae, causes a kinking of the vertebral column. Accessory traction on the tail is insufficient to completely overcome this angular displacement.

downwards. It is then passed under the fœtal abdomen and upwards between the flank and stifle on the opposite side. When it is securely insinuated in this position, the hand is passed over the hip, the introducer picked up and the cord drawn back out of the vulva. The introducer is removed and the free end of the cord threaded through the "eye," thus completing the snare. By slow traction the snare slips forward until it is situated over the sacral region of the fœtus, securely encircling its abdomen. The free end of the cord may with advantage be secured to the tail, thus obtaining another point for traction.

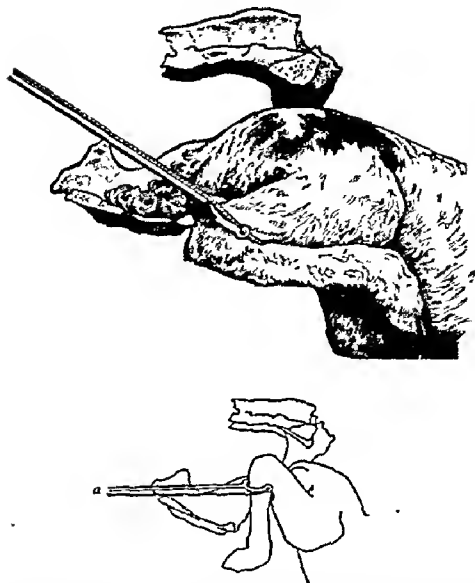


FIG. 121.—CORRECTION OF HIP-FLEXION POSTURE, USING A CRUTCH.

Stage II.—By traction on the crutch a state of disengaged hock-flexion posture is produced. After drawing the hock over the pelvic brim, the snare is loosened and the fork moved to the plantar aspect of the joint, *a*. The snare is retightened ready for correction of the hock-flexion posture.

3. Delivery by Traction with Hip-Flexion Posture Uncorrected. In unilateral cases forcible traction is applied to the normally extended limb without attempting to apply a traction cord to the abnormally placed one. The direction of traction is alternatively to the right and to the left of rather than immediately in the centre line. By this means the hip joints tend to pass into the pelvis successively rather than simultaneously, and thus, when it is a physical possibility for delivery in the abnormal posture to be brought about, this method facilitates it. When the fœtus is dead, traction can be reinforced by the use of an anal hook (see p. 221). For delivery of a bilateral case, traction on the tail alone is

As the fœtus is directly raised by the ventral traction cord, impaction of the buttocks against the rim of the pelvis is prevented.

Weinmann's snare (Fig. 124), which is similar to the preceding, consists of two cords. One is insinuated between the femur and the flank on each side and the snare completed, the "cyc" loop lying adjacent to the hip joint. The free ends of the cords are then twisted into a single traction cord. This form of snare is subject to similar mechanical disadvantages to those described for Saake's snare, for the following reasons: the musculature of the fœtal pelvis and the deep situation (towards the mesial plane) of the hip joints, together with the oblique forward and outward direction of the femora, results in the direction of the loops being oblique, in the postero-mesial direction; and thus traction causes the thighs to become abducted. The immediate result of its employment, therefore, is a widening of the already extensive transverse dimension of the posterior part of the fœtus. The stronger the traction employed, the greater is the outward displacement of the thighs. If the force employed is beyond the limit admissible, it is more likely to cause fracture of the maternal acetabulum than delivery of the fœtus (author's personal experience). The same disadvantage applies when two simple traction cords are passed around the hip flexures (Fig. 125).

4. **Delivery in Hip-Flexion Posture by Traction on an Anal Hook.** (Fig. 126). This method only comes into consideration when the fœtus is dead and the buttocks are so far advanced that the anus is situated at the vulva or in the vaginal antrum. Obermayer's hook is employed. It is inserted deeply into the fœtal rectum and fixed over the pubic border. A correctly applied hook is securely fixed. The efforts of two men cannot break the pubis of a well-developed calf. The central point to which traction is applied through the medium of the hook ensures that the buttocks are correctly directed in the pelvic axis without straddling of the thighs in front of the pelvis. When the buttocks are more or less freely movable in front of the pelvis, an attempt at delivery with the snare should be made before resorting to the hook.

Indications for Embryotomy. The object of embryotomy is to reduce the circumference of the pelvic girdle. In bilateral cases it is effected by the percutaneous amputation of one limb at the hip, using the disarticulating knife, Pfanz's embryotome, the chain saw or the wire saw. The best instrument for the purpose is the wire saw tubular embryotome, because the head of the instrument can be effectively fixed at the

Under favourable conditions—a small fœtus and a roomy pelvis—delivery of a case of bilateral hip flexion may be effected with Saake's snare. Unfortunately, however, in most cases, the direction of the force of traction being eccentric, dorsal angulation of the foetal lumbar region occurs, and the buttocks, freely movable and directed towards the border of the os pubis, become more and more impacted in the pelvis as traction increases. The result is that the presentation becomes converted into what may be described as an inverted "dog-sitting" posi-

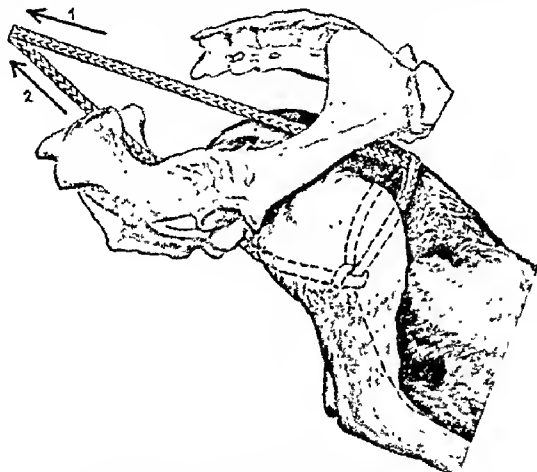


FIG. 123.—THE MODIFICATION OF SAAKE'S SNARE BY A SECOND TRACTION CORD FIXED VENTRALLY BETWEEN THE LIMBS.

It assists in raising the buttocks into the pelvic inlet.

tion, or dorso-vertical presentation, in which the fœtus rests, in the squatting position, on the pubis.

This can be avoided by a modification of Saake's snare (Fig. 123). It consists of a second traction cord fixed to the centre of that part of the snare lying under the foetal abdomen, and emerging between the two limbs. Traction on the two cords must be applied alternately and not simultaneously, with the result that the foetal buttocks are levered through the pelvic inlet in the longitudinal direction.

ischial arch. By this means section through the hip joint is ensured and the small portion of the articular head of the femur which remains in the acetabulum in no way interferes with subsequent delivery. Again, the possibility of sawing at an angle enables the direction of the saw to be adapted to each individual case (see p. 300). Sawing through the shaft or neck of the femur is always to be avoided, on account of leaving a sharp-edged stump. Amputation of the second hind limb is only necessary in exceptional cases. For delivery, the hind parts of the fœtus, now

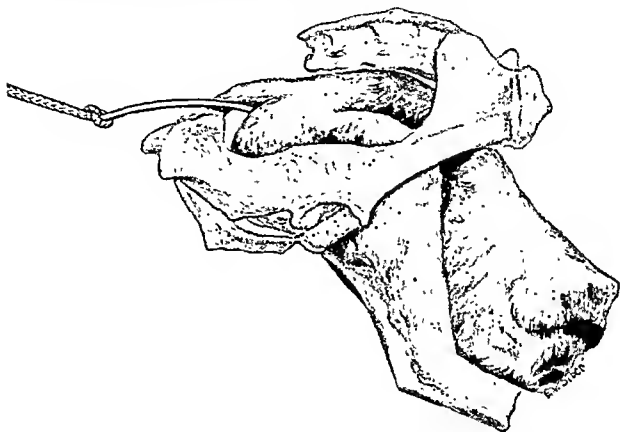


FIG. 126.—THE USE OF AN ANAL HOOK.

The most suitable method of delivering a dead fœtus by traction in breech presentation is by the use of an anal hook (Obermayer's hook in the figure).

reduced in circumference, are fixed with a modified Saake snare or with an anal hook. Possibly correction of the posture of the second limb will be considered, for after amputation of the first this presents less difficulty.

In unilateral cases it is, of course, better to amputate the abnormally placed limb than the normal one, but if suitable instruments for this are not available, it may be decided to remove the extended limb.

If the vakufakt is used and correction of the posture of the limbs cannot be effected after sawing out the coccygeal bones, the wire embryo-tome or the chain saw must still be employed.

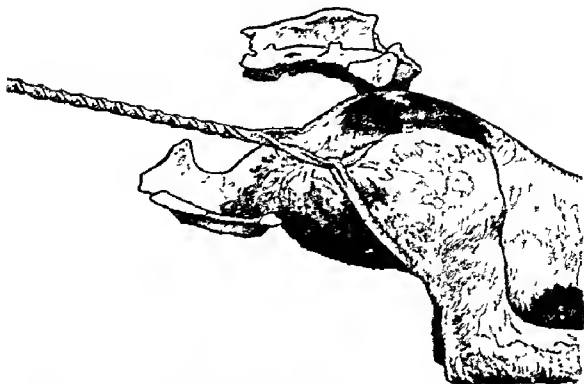


FIG. 124.—WIENMANN'S SNARE.

Disadvantages: Straddling of both thighs and the absence of a centrally acting force.

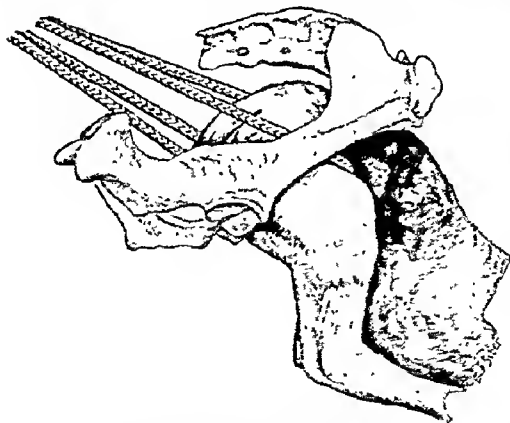


FIG. 125.—THE USE OF TWO SIMPLE HIP SNARES.

Disadvantage: The force acting laterally on each side of the thigh causes straddling of the latter in front of the pelvis.

foal in breech presentation and also on account of the length of the limbs, both the correction of the posture by hand and the application of

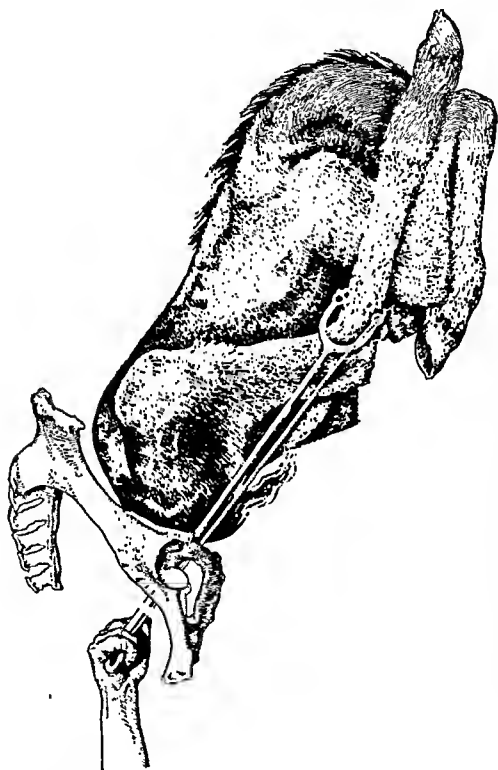


FIG. 128.—CORRECTION OF BILATERAL HIP-FLEXION POSTURE, USING KÖHN'S CRUTCH SNARE.

Stage II.—The fork is fixed by the snare on the outside of the limb, immediately below the hock joint. (It is often sufficient to advance the fork as far as the distal end of the tibia only.) After strongly tensing the snare the cord is tied to the crutch handle.

a snare are much more difficult than in the calf. When the mare is standing, this difficulty is increased owing to her greater height. The recumbent position of the mare (either lateral or dorsal) with the pelvis raised

THE MARE

Methods of Correction and Delivery

1. Extension of the Limb (One or Both) using the Hand Alone. Owing to the squatting position (already described) generally assumed by the

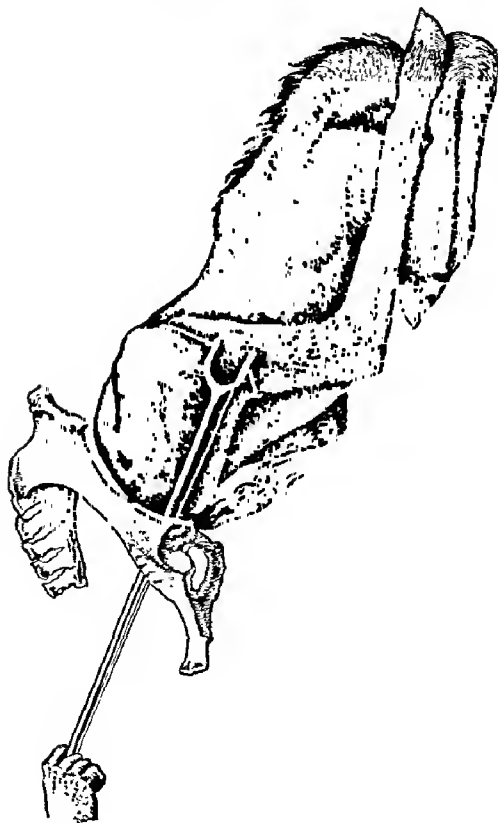


FIG. 127.—CORRECTION OF BILATURAL HIP-FLEXION POSTURE, USING KÜHN'S CRUTCH-SNARE.
Stage 1.—The snare is advanced distally over the stifle joint.

attempt may be made to deliver the foal without rectifying the posture of the second hind limb, by traction on the corrected one, with or without an anal hook. From this point the method is the same as for the cow (pp. 218 and 221).

2. Extension of the Limb or Limbs, using Kühn's Crutch Snare (Figs. 127, 128 and 129). This method is based, as in shoulder flexion posture, on the following principle: By fixing the limb near its free end, traction applied to the rigid rod produces flexion of the joints.

Method of procedure: The free end of the cord is passed between the thigh and the flank, from above below, and drawn out of the vulva. The loop is completed, and by traction on the cord the crutch is introduced into the vagina until the fork reaches the foetal buttocks. The handle is now grasped and the crutch, under slight tension on the cord, is guided down the lateral aspect of the limb until the fork lies just below the hock joint (Figs. 127 and 128). The cord, which up to this point has been held loosely, is drawn taut and securely fixed to the handle. In this way the fork is secured on the lateral aspect of the limb just below the hock joint by the snare passing around the proximal end of the metatarsus. By slow but forcible traction on the crutch the hock and stifle joints become strongly flexed and the posture converted into that of disengaged hock flexion (Fig. 129). The changed position of the tarsal joint generally causes the fork to glide automatically from the lateral to the plantar aspect of the joint (from the sagittal to the horizontal plane). If this does not occur, the hand is introduced to assist it. Correction of the hock flexion is effected in the manner described on p. 212.

When difficulty is experienced in advancing the snare below the hock joint, the fork is fixed to the distal end of the tibia and the instrument used as described on p. 217, and illustrated by Figs. 120 and 121.

3. Delivery of the Fœtus by Forcible Traction, using the Abdominal or Hip Snares. This method is only adopted in bilateral cases. The application of Saake's modified abdominal snare (p. 219) is only possible when the foetal buttocks, lying below the rim of the pelvis, can be drawn sufficiently far into the pelvic canal by elevation and traction on the tail, that the flanks and ventral aspect of the abdomen become accessible to the hand. This is greatly facilitated by placing the mother in the dorsal position. As the fœtus tends to fall towards the maternal vertebral column, the ventral aspect of the abdomen between the two thighs becomes easily accessible for the introduction of the snare introducer. When anaesthesia of the hind quarters is sufficiently pronounced, defensive kicking on the part of the mare is only very slight.

possesses the great advantage that by the application of epidural anæsthesia (40–60 c.c. of a 1 per cent. solution of novocain) straining becomes completely eliminated and at the same time there is no fear of the mare



FIG. 129.—CORRECTION OF BILATERAL HIP-FLEXION POSTURE, USING KÜHN'S CRUTCH SNARE.
Stage III.—By traction on the crutch, fixed either below or above the hock joint, a state of hock-flexion posture is produced. Correction of this is also effected with the fork, after rotating it from the lateral to the plantar aspect of the joint.

falling down. In addition, in the lateral position the upper limb becomes much more readily accessible, and it may be possible to bring it into a position of hock-flexion posture by means of a traction cord. Having corrected this posture, by one of the methods already outlined an

CHAPTER 19

DELIVERY IN IRREGULAR POSITIONS OF THE FŒTUS

IF during the early stages of labour the fœtus fails to rotate in the uterus or if rotation is incomplete, also if it is disturbed or prevented by premature interference, faulty positions of the fœtus develop—viz.:

(1) Right or left lateral position, by which is indicated that the dorsal aspect of the fœtus is directed towards the lateral aspect of the maternal abdomen in either anterior or posterior presentation.

(2) The ventral position, in which the fœtus lies with its vertebral column directed towards the abdominal floor of the mother, in either anterior or posterior presentation. When the presentation is anterior the head and fore limbs are generally extended towards the pelvic inlet; occasionally they may be associated with abnormality of posture.

The appropriate mechanical conditions for passage of the fœtus through the pelvis are only present when the former is in the dorsal position. The anatomical arrangement of its dorsal vertebral column—especially the spinous processes, the muscles between them and the transverse processes, and also the articulations—is such that ventral flexion only can occur. As the pelvic axis or guiding line presents in all the domestic species a dorsal curvature, natural delivery can only occur when the dorsal vertebral column of the fœtus can accommodate itself to this curvature, and this can only be served when it is presented in the dorsal position. There are, however, several other obstacles in cases of ventral position of the fœtus. Firstly, the limbs, because they cannot be flexed in the direction of the guiding line, become opposed to the pelvic roof; and, secondly, the vertebral column, which is unyielding, is directed towards the brim of the maternal pelvis. Lastly, the largest transverse diameter of the fœtus (the shoulder-elbow region in anterior presentation and the stifle joints in posterior) enter the pelvic cavity in its dorsal segment under conditions less favourable for delivery.

THE COW AND THE MARE

Mechanism of Correction of the Position and Subsequent Delivery

An effort to rotate the fœtus into the dorsal position before or during the application of traction should be made in every case, except those in

The successful delivery of a breech presentation by alternating traction on the dorsal and ventral cords of the modified Saake's snare can only be expected in the case of a relatively small foal in a light mare. In coarse-bred, heavy foals the method is not to be considered, for the bulky muscles of the croup and the marked outward projection of the stifle joints present an absolute obstacle to delivery. In these the best treatment is either correction of the malposture or the adoption of embryotomy.

In using the hip snare (Weinmann's) the same principles hold good as for the cow (p. 221), except that in the case of a weakly developed foal in a roomy mare, delivery is more likely to succeed than in the calf. The reason for this is that owing to the comparatively slight development of the muscles of the croup and thighs, the snare glides more deeply into the hip flexure, and consequently the lateral tension against the femur is much less and the stifles become better adapted to the sides of the abdomen.

4. **Delivery by the Use of an Anal Hook.** It is only in strongly developed foals, such as the heavy breeds and the muscular half-breeds, that the pelvic floor is of sufficient strength to allow delivery by traction, using a hook. It has already been pointed out that forced traction in breech presentation is only to be considered in weakly foals, and thus great caution is necessary in the use of the anal hook. As a general rule it is indicated, as an accessory means of traction, in unilateral cases, for in these the anus is more easily accessible for its introduction. In bilateral cases it cannot be inserted without first raising the buttocks above the pelvic brim, for the reasons outlined on p. 221.

Indications for Embryotomy. Embryotomy in breech presentation is generally more often necessary in the mare than in the cow, on account of the deep situation of the buttocks in front of the pelvic brim, the greater length of the limbs, and the more rapid and extensive swelling of the vagina. The principles are the same as for the cow (p. 221).

(a) The head and neck lie more or less extended beneath the limbs in front of the pelvis, or the fore limbs and the mouth have already entered the pelvis.



FIG. 130.—ANTERIOR PRESENTATION, VENTRAL POSITION, NAPE AND CARPAL FLEXION POSTURES. In ventral position the frequency with which one encounters the limbs in the extended or flexed postures is about equal. When flexed, the limbs lie in the abdominal cavity with the fetlock joints directed towards the pelvic roof.

(b) The head, opposed by the pelvic brim, has become more or less laterally flexed, and lies below it. Correction can be effected as follows:

1. By the Excitation of Reflex Movements in the Fœtus (after Sjöberg). This method applies only to cases of anterior presentation in which the fœtus is living. Using the thumb and middle finger as a forceps grip, the ocular grooves are securely held, and equal and firm pressure is applied to the eyeballs for several minutes.

which the fœtus is abnormally small and delivery almost occurs naturally. Although it is possible to effect rotation with the mother in the recumbent position, the mechanical conditions necessary for the operation are better served by the standing position. When faulty posture of the head is present at the same time, the general rule is that it should be corrected first—that is, before attempting to alter the position of the fœtus. In some cases and under special conditions, however, it is necessary to depart from this rule.

A. Lateral Position (in Anterior or Posterior Presentation)

Rotation of the fœtus can be effected as follows:

1. **By Unilateral Traction of the Uppermost Limb.** In anterior presentation snares are applied to both fore limbs and the head. In the case of the latter by eye hooks, if possible, otherwise by a mandible snare. Tension is applied to fix these parts. The hand is introduced beneath the ventrally placed limb until it reaches the side of the fœtal thorax and grasps the humerus close to the shoulder joint. It is lifted as far as possible in the upward and mesial direction, whilst at the same time traction is exerted on the upper foot in the opposite direction—i.e. in the right lateral position downwards and towards the left, and in left lateral position downwards and to the right. As rotation progresses through an angle of 45 degrees in the dorsal direction, traction must be continually directed along the guiding line, i.e. ventrally, until rotation is complete. When rotation is impeded by dryness of the genital passage, the operation can be facilitated by the induction of epidural anæsthesia followed by the infusion of linseed mucilage.

Correction of the lateral position in posterior presentation is best effected by applying strong unilateral traction on the dorsal limb, but before the fœtus enters the pelvis the hand should be inserted and the stifle joint grasped. By pressure upon it the quarter-circle rotation into the dorsal position is effected.

2. **By provoking Reflex Movements of the Fœtus** (see below).

3. **By the Use of the Torsion Fork** (p. 223). For the rotation of the fœtus through a quarter-circle only, this instrument is seldom required.

B. Ventral Position (Anterior or Posterior Presentation)

Correction of this position is generally simpler when the presentation is posterior, because in anterior presentation the head impedes rotation. In the latter there are two possibilities to consider:

from below to the right, the right limb is drawn downwards and to the left, while the left, lying beneath it, is crossed to the right side. Rotation is facilitated by additional pressure applied to the maternal abdominal wall. An assistant applies his back against the right lower flank, and on the word of command presses from below upwards.



FIG. 132.—THE USE OF THE TORSION FORK FOR ROTATING THE FŒTUS FROM THE VENTRAL POSITION IN POSTERIOR PRESENTATION, EXTENDED POSTURE.

3. By Rotation of the Fœtus using Cämmerer's Torsion Fork. This instrument was introduced for the correction of certain cases of uterine torsion. It is also suitable for rotating the fœtus in cases of ventral position. To be successful the fœtus must be freely movable within the

The hand is then withdrawn and the case watched for 5-10 minutes. Sometimes active movements of the fœtus will be observed in the right flank of the mother and a subsequent internal examination may reveal that the calf has actually rotated on its longitudinal axis and has assumed the lateral or even the dorsal position.

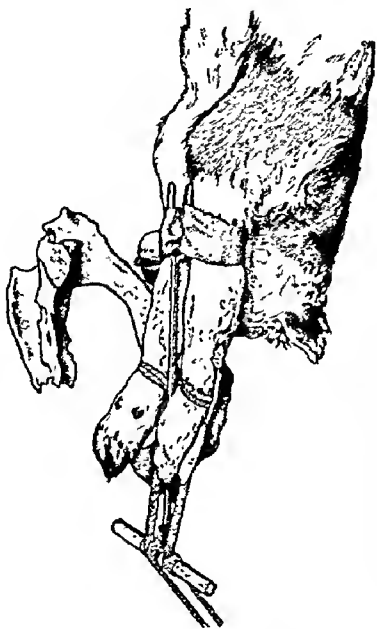


FIG. 131.—ROTATION OF THE FÆTUS, WITH THE HEAD DIRECTED TO THE LEFT SIDE IN ANTERIOR PRESENTATION, FROM THE VENTRAL TO THE DORSAL POSITION, USING THE TORSION FORK.

Rotation is from right to left.

2. By Manual Rotation, Force being applied to the Head and Crossed Limbs. The limbs, extended in the genital passage, are snared, as also is the head. For the latter eye hooks are preferable, otherwise a mandibular snare is employed. The limbs are first crossed and then the operator grasps the head at the orbital grooves, rotating it laterally through a quarter-circle. This is facilitated by traction on the limbs in the appropriate direction by an assistant. For example, if the head is to be rotated

often employed by laymen. It is not, however, without danger, for there is a risk that complete separation of the fœtus from the uterine wall is not attained by simple retropulsion and rotation.

5. **By Rotation of the Partially Delivered Fœtus.**—This method is attempted when complete rotation of the fœtus in the uterus presents difficulties. It is often possible, however, to produce an oblique position. Complete rotation may then be effected after the anterior or the posterior end of the fœtal body has entered the pelvis. It is only possible when the proportion between the size of the pelvic inlet and the circum-

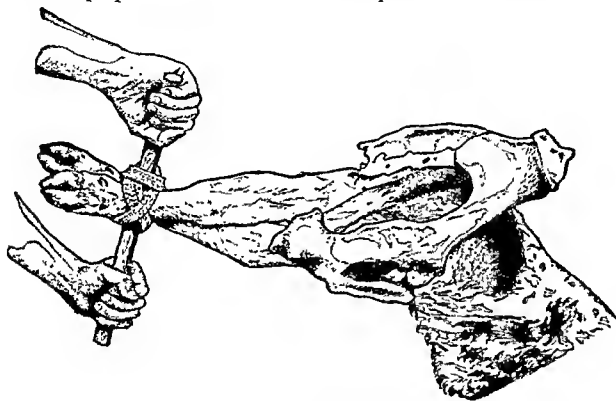


FIG. 133.—ROTATION OF THE FÆTUS FROM THE VENTRAL POSITION IN POSTERIOR PRESENTATION, USING A CROSSBAR BETWEEN THE LIMBS.

Rotation is complete as regards facility for delivery, although the fœtus is not completely in the dorsal position.

ference of fœtus is approximately normal, and there is always a danger of rupture of the uterus occurring. The method is often successful in mares owing to the favourable size of the shoulders and head of the foal. The well-constructed roomy pelvis in the mare also plays a part in the result.

Indications for Embryotomy. As a rule removal of the head or the limbs for the correction of this position, in a fœtus of normal size and form, is unnecessary. Even in the case of an abnormally large fœtus an attempt should be made to correct the position before resorting to

uterus, for if the wall of the latter is closely applied to the fœtus the uterus will be rotated as well. For this reason in protracted cases slight epidural anæsthesia and the liberal infusion of linseed mucilage are necessary. If the operation has to be performed with the mother recumbent, the dorsal position is preferable to the lateral.

Correction in anterior presentation is effected as follows: The canvas cuffs are passed over the snared digits and up the legs as far as possible towards the elbows. The prongs of the torsion fork are inserted through the cuffs. The cords of the limb snares are passed through the eyes at the handle end of the instrument, drawn taut and tied (if ordinary snares, which will not readily pass through the eyes, have been employed, they may be secured to the wooden rod of the instrument). By rotating the rod the whole fœtus becomes rotated. In cases in which the head prevents complete rotation into the dorsal position, its movement must be assisted by a hand introduced into the uterus. Rotation in posterior presentation is much simpler, and is performed upon similar lines. Correction of the abnormal position by this method has advantages over method 4, because rotation of the fœtus takes place in front of, where there is much more room, rather than in the pelvic cavity. The fœtus can be repelled into the uterus as far as is necessary before rotation is commenced. When dealing with posterior presentation it is undesirable that the fœtus shall be completely rotated into the dorsal position, but that it shall be incomplete and delivery effected in the semi-lateral position, in accordance with the principles outlined on p. 151.

4. By Rotation of the Fœtus, using a Crossbar between the Bound Limbs (Fig. 133). For mechanical reasons this method can only be applied for the correction of ventral position when the presentation is posterior. In anterior presentation the digits only project from the vulva, whereas for the successful application of the method it is essential that at least half the cannon bone shall be exposed. In addition the joints of the fore limbs, and especially the attachment of the scapula to the thorax, are too movable for rotation to be effected by this method.

The exposed hind limbs are crossed and securely bound by a figure-of-eight cord just above the fetlock joints. A rod of medium strength is then passed between the cannon bones (it is an advantage to insinuate it between the figure-of-eight cord) and axis rotation of the fœtus produced, either directly when the mother is in the standing position by powerful rotation of the rod, or indirectly when she is recumbent by fixing the fœtus with the rod and rotating the mother through an angle of 180 degrees. This method, which is entirely dependent on force, is

CHAPTER 20

DELIVERY IN IRREGULAR PRESENTATIONS

EVERY deviation of the long axis of the fœtus from the longitudinal direction results in a faulty presentation. The fœtal vertebral column may lie in front of the maternal pelvic inlet in a sagittal or a transverse plane. In the first case vertical presentation develops. In it the head is always directed dorsally and the buttocks ventrally. In the second, transverse presentation develops, in which one end of the body is directed to the left and the other to the right of the maternal pelvis. According to which aspect of the fœtal body, dorsal or ventral, is directed towards the pelvis, the terms dorso- or ventro-vertical and dorso- or ventro-transverse presentations, are applied.

Whether the presentation is vertical or transverse, it is seldom that the fœtus assumes such a position that both extremities of the body are equally distant from the pelvic inlet. As a rule one end lies nearer the pelvis than the other, so that the long axis of the fœtus lies more or less obliquely to that of the mother. In these cases it is not customary to speak of "oblique presentation," but simply of vertical or transverse.

Vertical Presentations

A. Dorso-vertical Presentation

Of all abnormal presentations this is the most uncommon. The fœtus lies in such a position that its back or the withers are directed towards the pelvic inlet, and it is, to a certain extent, sitting in the uterus. It may be assumed, fairly correctly, that dorso-vertical presentation represents the normal position of the fœtus *in utero* during gestation, with some dorsal displacement of the anterior extremity of the body. The cause must be attributed to premature rupture of the membranes, by sudden straining, before extension of the limbs and rotation of the trunk can take place.

THE COW AND THE MARE

The main object of manipulative interference is to bring about direct presentation, after which the case can be further treated according to the methods described.

embryotomy, because axis rotation of the fœtus is more difficult to effect after the amputation of the head or a limb, and to deliver the fœtus by traction in the ventral or lateral position is unphysiological and therefore dangerous. A slight degree of lateral deviation, however, presents no obstacle to delivery, and in this case the subcutaneous or percutaneous amputation of a limb may be carried out provided conditions are suitable (p. 277). In any case attempts at delivery with the head in the lateral position are to be avoided, especially in the cow. Success is more likely in the ventral position.

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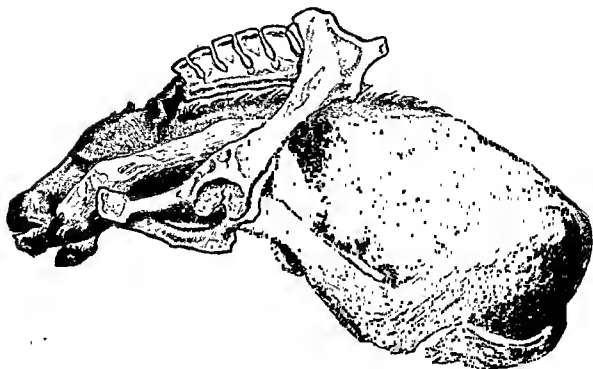


FIG. 134.—VENTRO-VERTICAL PRESENTATION ("DOG-SITTING" POSITION), WITH THE ANTERIOR END OF BODY STILL LYING IN THE PELVIS.
Turning into posterior presentation is still possible.

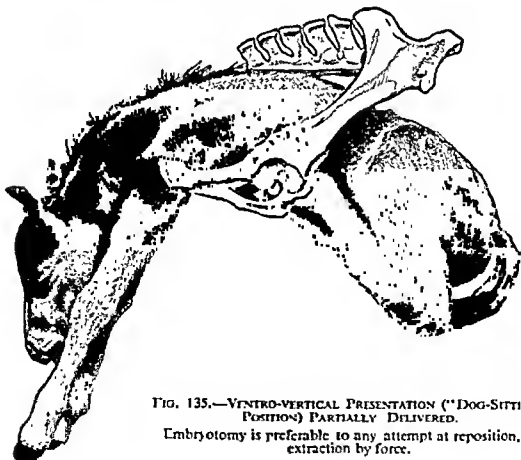


FIG. 135.—VENTRO-VERTICAL PRESENTATION ("DOG-SITTING" POSITION) PARTIALLY DELIVERED.
Embryotomy is preferable to any attempt at reposition, or extraction by force.

As no limbs are available for fixation of the fœtus, an attempt must be made, using Schöttler's double hooks, or in some other way, to bring one end of the trunk towards the pelvic inlet, so that snares may be applied to the limbs and/or the head.

According to whether the anterior end with the neck or the posterior end is nearer the pelvis, correction is effected in one of two ways:

1. By conversion into anterior presentation, ventral position, with subsequent rotation into the dorsal position, correction of posture being first performed on the head and then on the limbs. By drawing the extremity of the fœtus into the pelvis, the vertical presentation tends to change spontaneously into the direct presentation, but in the ventral position. Rotation on the longitudinal axis is then effected in the manner already described (p. 230).

2. By conversion into breech presentation by traction on the tail or by means of sharp hooks inserted into the buttocks, and subsequent delivery according to the principles already stated. To determine whether or not this procedure is possible it is best to make an examination with the mother restrained in the dorsal position.

Indications for Embryotomy. Sufficient observations on this subject are not available, and the scanty reports in the literature give no definite indications. In each individual case embryotomy must be adapted to the conditions which predominate, using the vakufakt or the wire saw embryotome. In general it is performed in the same way as in dorso-transverse presentation.

B. Ventro-vertical Presentation ("Dog-Sitting" Position)

In comparison with dorso-vertical presentation this is more frequent, especially in the mare (Figs. 134, 135). As a rule the case appears to be one of normal, anterior presentation, with the head and fore limbs lying extended in the vagina, and the "dog-sitting position" is only suspected from the difficulty encountered in delivery. This difficulty is due to the characteristic sitting position of the fœtus in the uterus, with the hind limbs strongly flexed at the hip joints and their digits either impacted against the brim of the pelvis, or lying in the vagina alongside the fore limbs. In some cases the hind limbs lie with the phalanges pressed against and below the pubic brim, or the condition (after unscientific lay

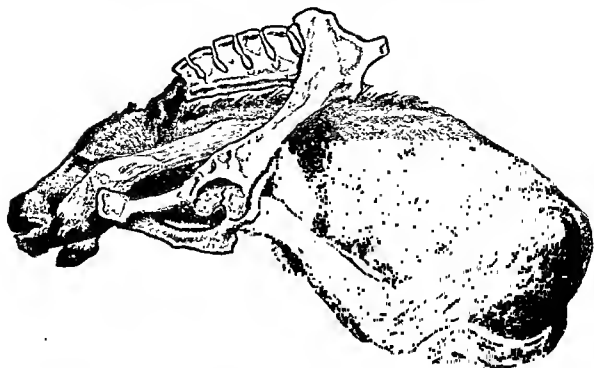


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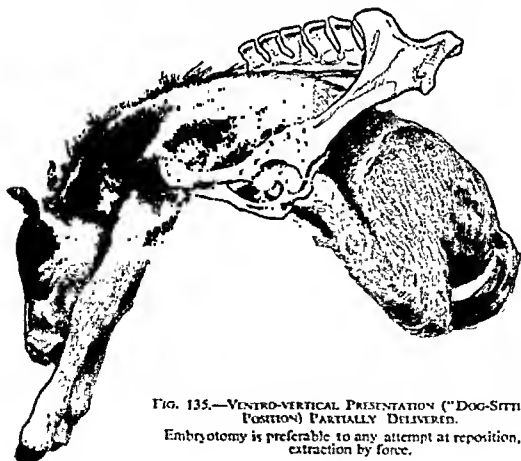


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The methods which may be adopted are as follows:

1. **Conversion to Normal Anterior Presentation.** In the calf, owing to its shorter limbs, this method is sometimes successful, but is only applicable in recent cases in which there is no impaction of the anterior part of the trunk in the pelvis. Both hind legs are grasped, in succession, at the fetlock joints, and by pressure in the cranio-ventral direction, as far as the length of the arm will allow, all the joints are strongly flexed and pushed back into the uterus. Provided that the hind limbs are sufficiently displaced from the pelvis into the depth of the uterus, and remain in that position, the fœtus can be delivered in anterior presentation.

2. **Conversion to Posterior Presentation, Ventral Position, by Means of Kühn's Crutch (Figs. 136, 137)** (in the same way as turning is effected in human obstetrics). This method is especially applicable when the hind limbs have entered some distance into the vagina. Rotation of the fœtus in the vertical plane around a transverse axis passing through the centre of the body, depends upon the principle of the simultaneous action of opposing forces on each end of the body.

This is effected as follows: The fore limbs are snared and drawn taut, and a canvas cuff is passed over each fetlock joint. By means of the hand at first, and later the fork of the crutch, each of the cuffs is passed up the leg towards the elbow joint. One prong of the fork is inserted in each cuff. In order to prevent flexion of the elbow and shoulder joints during the operation of reposition, the snares are tensed and wound several times around the handle of the crutch. Next follows fixation of the hind limbs. This is effected by attaching a snare above each fetlock joint. Rotation is then carried out by the application of slowly increasing pressure exerted by the operator on the crutch (force 1), whereby the fore part of the body is repelled, in the dorso-cranial direction, deeply into the uterus, while an assistant rotates the body by traction on the hind limbs (force 2). As a rule the fœtus glides spontaneously into the direct presentation once the anterior part of the body has passed a certain critical point—that is, when the thorax becomes further removed from the pelvic inlet than the buttocks.

The use of the crutch for the correction of ventro-vertical presentation possesses the following advantages:

1. The operator is able to exert very strong and effective pressure on the trunk.
2. This pressure still takes effect at a point beyond the reach of the arm.

interference, Fig. 135) may be as is sometimes described in the report of the owner: "The front part of the foal as far as the shoulder blade can be extracted comparatively easily, after which it cannot be delivered even by forcible traction." Strictly speaking, in the case thus described, ventro-vertical presentation no longer exists, for it has been transformed, by forced traction on the anterior part of the fœtus, into an anterior presentation with hock flexion posture, and impaction of the hind limbs against the pelvic brim.

The diagnosis of ventro-vertical presentation presents no difficulty when the fœtal thorax has not entered the pelvis, for the hind limbs, directed towards the pelvic inlet, are always within reach of the hand. When, however, the anterior part of the body already lies in the pelvis, the difficulty of diagnosis is usually insuperable, as it is only possible in the most exceptional cases to force the hand through the vagina along the fœtal thorax so as to reach the hinder parts of the body. The differentiation, in such cases, of dog-sitting position from absolute oversize of the fœtus, ascites of the fœtus, or a double monster, is of no importance in treatment. In all these cases delivery can be effected only in one way—i.e. by embryotomy—section of the fœtus at the lumbar vertebræ. After this operation is performed delivery presents no difficulties.

THE COW AND THE MARE

Mechanism of Correction and Delivery

On the whole, the principle that it is preferable to make an effort to correct a difficult presentation when conditions render it possible, or to perform embryotomy, rather than to attempt delivery of the fœtus by forcible traction on all four extremities, holds good.

Attempts at the delivery of a ventro-vertical presentation by forcible traction on the head and fore limbs, in the hope that extension of the hind limbs will occur spontaneously during extraction, are, in a normally sized fœtus, quite fruitless and even dangerous. Although descriptions of cases may be found in the literature in which forced delivery, in the dog-sitting position, was effected without injury to the mother, such cases are exceptional, and can occur only when the maternal pelvis is exceptionally roomy, and the fœtus is very small (less than 10 per cent. of the mother's weight). When the danger of such a procedure is recognized it will be avoided, even when more troublesome work is to be expected.

and consequently to a relatively large area of the body. Thus the mechanical conditions necessary for the action of the propulsive force on the foetal body are fulfilled in the most ideal way.

As soon as posterior presentation (ventral position) is produced, the



FIG. 137.—CONVERSION OF VENTRAL PRESENTATION INTO POSTERIOR POSITION, BY THE CRUTCH-CUFF METHOD.
Second stage: The anterior part of the fetus is displaced as far as possible in the cranial direction. Then follows removal of the instrument and rotation of the fetus from the ventral to the dorsal position before delivery.

crutch is withdrawn, after detaching the two snares from the handle. When the hand cannot reach the fetlock joints of the fore limbs for their removal, the two snares simply fall into the uterus. They may be delivered, together with the cuffs, on the foetus, after rotation into the dorsal position has been effected. The cuffs themselves usually become

3. Slipping of the instrument during the operation is impossible, as also is flexion of the knee and elbow joints.

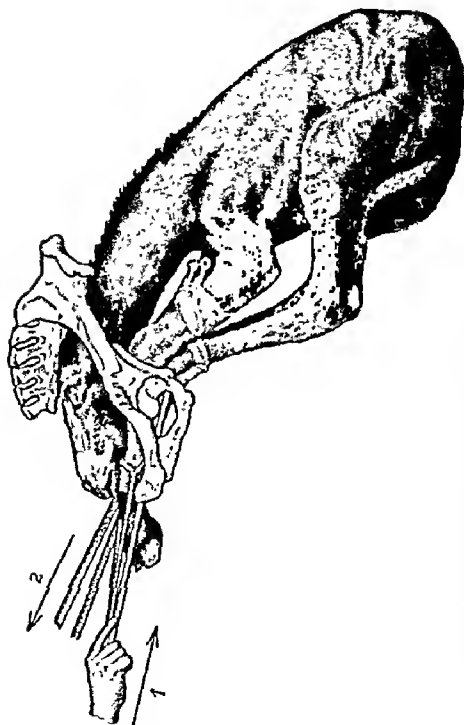


FIG. 136.—CONVERSION OF VENTRO-VENTRAL PRESENTATION INTO POSTERIOR PRESENTATION, BY THE CRUTCHFIELD'S METHOD.
First stage: Under deep epidural anesthesia in the mare, and after the liberal infusion of linseed mucilage, the anterior end of the body is displaced ventrally. Traction is then exerted on the hind limbs until the anterior part of the body has exceeded the state of equilibrium.

4. The pressure exerted simultaneously on both forearms and elbow joints is, owing to artificial rigidity of the limbs, transmitted through the upper arm and shoulder blade to both sides of the thorax,

sensation, the foetus lies with its back situated transversely, in a nearly horizontal plane, in front of the pelvic inlet (Fig. 138), one end of the body being directed to the right, the other to the left.

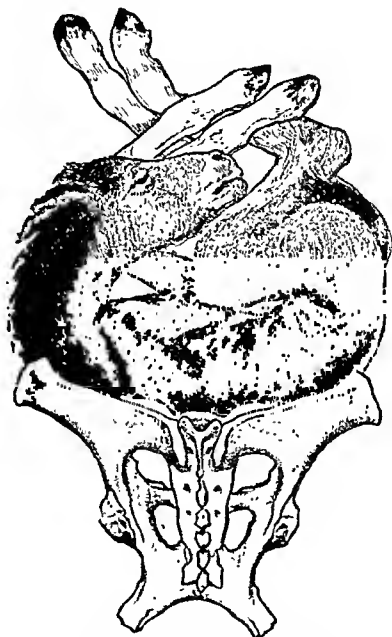


FIG. 138.—DORSO-TRANSVERSE PRESENTATION.

The fore parts of the body lie nearer to the pelvis than the hind parts.

Diagnosis sometimes presents difficulties, chiefly in deciding to which side the fore part of the body, with the head, is directed. Provided that the foetus is well within reach of the hand, this can be detected by palpation. Distinctive signs of the fore part of the body are, the spinous processes of the withers, the shoulder blade and the ribs; and of the

stripped off the limbs during delivery of the fœtus, and are subsequently removed from the uterus.

It is obvious that in the method of turning just described, if the fœtal parts are already engaged in the pelvis, operation will be facilitated and the danger of rupture avoided by the use of epidural anæsthesia and the liberal infusion of linseed mucilage.

3. The Method of Obisch. This only comes into consideration in exceptional cases. It consists of producing maximum extension of all joints of the hind limbs by strong traction, together possibly with retro-pulsion of the thorax. In this way extraction of the fœtus is attempted by traction on all four limbs and the head. In the author's experience this method involves great danger to the mother, and consequently he has abandoned it for some years.

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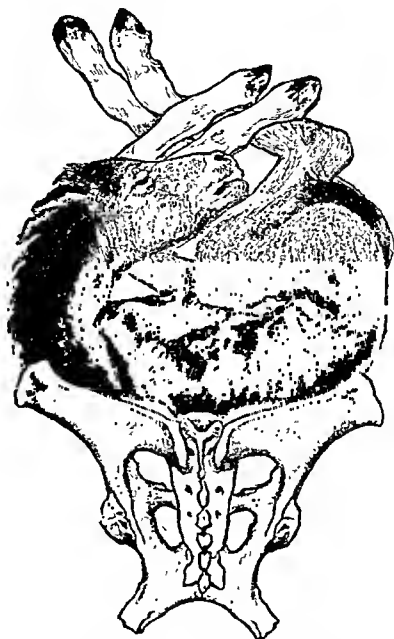


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Indications for Embryotomy: *Condition 1.* The foetal thorax lies in the vagina or has, at least, partly advanced through the pelvis. In mares this is not uncommon. The chief object of operation is transverse division of the trunk in the lumbar region (p. 309), in order to extract the hind limbs. For this operation the wire saw embryotome is suitable, the head of the embryotome being placed on top of the lumbar vertebrae. If difficulty is experienced in introducing the wire, both of the fore limbs together with the shoulder blades are removed previously (or exenteration may be performed). If a wire saw embryotome is not available, division of the trunk can be performed within the vagina, with a spatula and hand embryotome, a flap being formed to cover the lumbar stump (p. 311). Removal of the shoulder girdle (already outside the vulva) by a circular incision behind the last rib, and the forcible retropulsion of the stump, will sometimes allow turning to be performed, but this is not without danger.

Condition 2. The foetal thorax lies impacted in front of, or within the pelvic inlet. In this case attempts at turning may succeed after removal of both fore limbs at the elbow or shoulder joints with an open section (p. 288). The stumps, however, cause a considerable risk of rupture of the uterus during delivery, especially when division has been made by the wire saw embryotome. For this reason complete removal of the fore limbs with the shoulder blades is to be performed whenever possible.

Transverse Presentations

A. Dorso-transverse Presentation

In this irregularity, which is fortunately uncommon both in the cow and the mare, and is much rarer than the second form of transverse pre-

dorsum of the fœtus during turning (Fig. 139), the following method may be employed:

The free end of the cord is passed by a suitable snare guide either



FIG 139.—CORRECTION OF DORSO-TRANSVERSE PRESENTATION BY MEANS OF OPPOSING FORCES (PRESSURE AND TRACTION).

(a) around the outer wall of the fœtal abdomen, or (b) drawn through the abdominal cavity. In the latter case an incision is made on each side

hind part, the iliac crest, the lumbar transverse processes, and the sacrum. A decision on this point is necessary, for upon it depends the procedure of turning the fœtus on its longitudinal axis to be adopted.

THE COW AND THE MARE

Mechanism of Correction and Delivery

For delivery of the fœtus without resorting to embryotomy, rotation on its longitudinal axis into the lateral position is necessary, the latter subsequently being converted to the dorsal position in the manner already described. If the hind parts of the fœtus lie nearer the pelvis or if both extremities are at about an equal distance from it, the rule in both forms of transverse presentation is that it must, when possible, be changed to posterior presentation, for the following reasons:

1. At the hind end of the body there are only two parts to be fixed for traction, whereas at the fore end there are three.

2. The hind limbs, owing to the greater stability of their joints, are better adapted to rotation and extraction than are the fore limbs, with their looser attachment to the trunk and their association with the freely movable head.

3. If turning is performed at the fore end of the body there is a danger of producing a state of dorso- or ventro-vertical presentation.

Conversion of dorso-transverse into direct presentation is difficult, and sometimes impossible. Success depends, in the first place, upon the possibility of reaching the buttocks with the hand. If this is possible, a traction cord may be fixed to the anal or ischial region by means of a double hook, or it may be introduced by a snare guide into the groin of the dorsally placed limb. Pressure is then exerted on the fore end by the hand or a crutch.

If the conditions present indicate that turning at the fore part of the body is more practicable, a traction cord is passed around the neck or the shoulder flexure, whilst pressure is exerted by the hand or crutch on the other end of the body, to bring about rotation. When using a crutch there is danger of it slipping. If, after the first attempt at traction, the head is brought within reach, it is immediately fixed by eye hooks or a mandibular snare and its posture corrected. In cases of hydrocephalus, turning into anterior presentation is always indicated, for the size of the head must first be reduced before delivery can be effected.

To avoid slipping of Kühn's crutch when applied obliquely to the

nearer the pelvic inlet than the hind part, or the converse. Thus the long axis of the fœtus is oblique to that of the mother. At the same time cases are met in which both ends of the fœtus are approximately the same distance from the pelvis (the author's personal observations in the cow and mare).

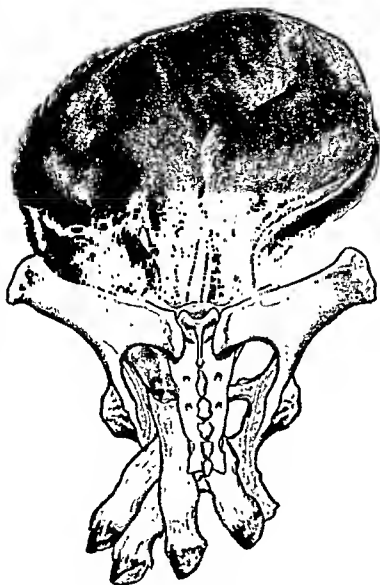


FIG. 140.—VENTRO-TRANSVERSE PRESENTATION WITH HEAD ENGAGED (THE MORE COMMON FORM).

The diagnosis of ventro-transverse presentation, after careful palpation of all parts of the fœtus within reach of the hand, presents no special difficulties. It must be first determined that the four limbs lying in the vagina belong to one fœtus, and that it is not a case of twin pregnancy with the simultaneous entry of the fore parts of one fœtus and the hind parts of another. If this question cannot be decided at once, by the

of the vertebral column with a finger knife. The cord is then drawn out and the snare completed. The crutch, as far as conditions permit, is applied against that end of the body which is to be replaced within the uterus. After tightening the snare and fixing the cord to the handle, strong pressure can be exerted obliquely to the fetal spine at the end of the body concerned, without fear of the instrument slipping. At the same time, by the opposing traction of the firmly fixed and corded hooks, the other end of the body is drawn towards the pelvic inlet.

In most cases of dorso-transverse presentation, however, the necessary mobility of the fetus can only be obtained after embryotomy.

Indications for Embryotomy. Not only is correction of this abnormal presentation most difficult, but successful embryotomy is also one of the most arduous tasks the obstetrician is called upon to perform. Great difficulty is generally experienced in passing the snare carrying the chain or wire saw, which is necessary for division of the trunk, around the fetus. In any case, division of the dorsal vertebrae after evisceration of the abdominal cavity must be attempted first (p. 312). After dividing the bony frame, favourable conditions are obtained for complete division. Removal of the anterior and posterior parts of the body is then effected by ensnaring the corresponding extremities. When using single sharp hooks for extraction of the halves of the trunk, great caution is necessary. The author's results have been unfavourable. Double hooks are to be preferred. In the case of pronounced oblique presentation, with the femur or humerus within reach of the hand, amputation of the dorsally situated limb (separation at the shoulder blade or at the hip joint, preferably by the wire saw embryotome) considerably facilitates further operative procedures.

B. Ventro-transverse Presentation

The fetal body is approximately in the horizontal plane with its abdominal surface directed towards the pelvis, usually with both pairs of limbs in the vagina. The head may lie laterally with the face turned more or less towards the maternal pelvis and within easy reach of the hand (Figs. 140, 141 and 142); or, and more frequently, it is displaced backwards and out of reach.

Reports in the literature are in agreement that ventro-transverse presentation is more frequent than dorso-transverse, and also that it is more common in the mare than in the cow. In most cases the presentation is oblique or inclined—i.e. the fore part of the fetal body lies

reflexus,* which is common in the cow, but rare in the mare, by the fact that the limbs of the monster are directed towards the pelvis† as follows:

1. The soles of the fore and hind limbs are not as a rule directed

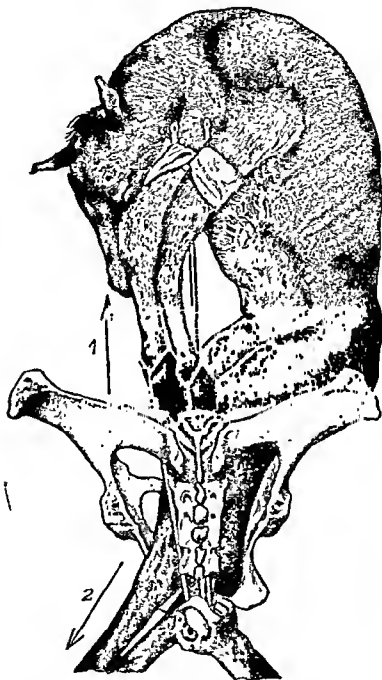


FIG. 142.—TURNING OF THE FŒTUS FROM VENTRO-TRANSVERSE TO POSTERIOR PRESENTATION, LATERAL POSITION, COMPLETED (SECOND STAGE).

The fœtus is extracted after removal of the crutch.

* The malformation is also found in the pig and goat. The only recorded case in the horse is by Schöttler (*Berlin. tierärztl. Wschr.*, 1922), but details are not given.

† Cases of schistosomus reflexus may also occur in which the bow-shaped spine, together with the free-lying viscera, rather than the limbs, project into the pelvis.

discovery of two independent trunks lying together lengthwise in the uterus, it should be borne in mind that transverse presentation is indicated by the association of a dorsally situated fore limb with a trans-

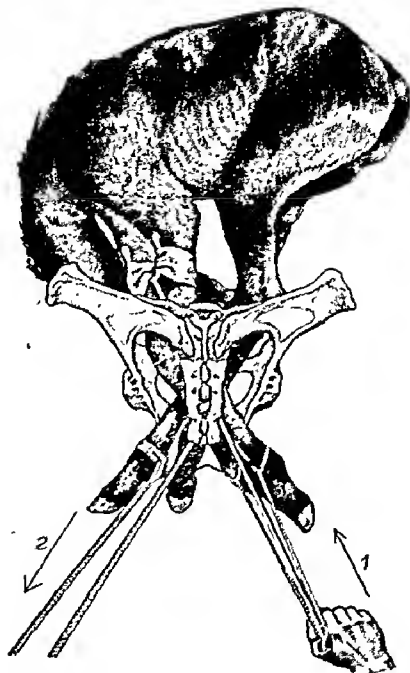


FIG. 141.—VENTRO-TRANSVERSE PRESENTATION WITH VENTRAL DISPLACEMENT OF THE HEAD.

Turning of the fetus by the crutch-cuff method is commenced. Pressure against the fore part of the body, and simultaneous, light traction on the hind limbs (first stage).

versely situated trunk, to which also belongs a dorsally placed hind limb, directed towards the pelvis. It is fairly easy to differentiate the presentation under discussion from the malformation schistosomus

the application of traction and pressure. It is nearly always advisable, both in the calf and the foal, to convert the case to one of posterior presentation, because the posture of the head then presents no difficulty (see also mechanism in dorso-transverse presentation).

Rotation of the fœtus (turning in the approximately horizontal plane) can be performed in two ways:

1. After attaching a foot snare to each of the hind limbs, the anterior part of the fœtus is grasped by the hand, with the thumb behind the elbow and the four fingers on the shoulder blade of the more accessible limb (Bruin's method). By slowly increasing pressure the fore part of the fœtus is repelled, whilst at the same time an assistant draws on the hind limbs.

This method often fails, either because the fore part of the fœtus cannot be reached by the hand or when the thorax is grasped the length of the arm is insufficient to produce that oblique position of the fœtal body required for turning. The use of an ordinary crutch inserted into the axilla is not suitable, on account of the danger of slipping and perforation of the uterus (personal observation). Again, by this method pressure is applied on one side of the body only (right or left), and not on the whole of the fore part.

2. Much better results can be obtained with Kühn's crutch (Figs. 141, 142 and 143), used as follows:

The fore limbs are snared and strong cuffs are applied to each leg as high as possible, towards the level of the elbow joint. The crutch is then passed along the stretched forelegs, and one prong of the fork inserted into each cuff. After forcible traction on the limbs both snares are made taut and fixed to the handle by several turns, or by tying, so that no loosening can occur during retropulsion of the fœtus. After fixing a snare to each hind limb, the cords of which are handed to an assistant, the work of reposition commences.

Increasing pressure is cautiously applied on the crutch, not in a straight line, but obliquely forwards and outwards, against the fore part of the fœtal body, until the greatest resistance is overcome. This occurs when the fœtus, by rotating on its longitudinal axis, has passed from the absolute transverse position. The assistant is now instructed to exert careful traction on the hind limbs. During this traction on the hind end, which produces an oblique position of the fœtus, the fore part of the body is pushed forwards by the firmly fixed crutch until the direct position of the fœtus, in the uterus, is attained. After passing the position of equilibrium the fœtus slides backwards into the uterine cavity almost

towards one side, as in ventro-transverse presentation, but away from each other.

2. Instead of the abdominal cavity being closed, it is open, with its convex, outer surface bearing the serosa carrying the abdominal and thoracic viscera, while the cleft-shaped body cavity, lying between the limbs, is covered by hairy skin.

The differentiation of ventro-transverse presentation from other malformations of parts of the body, or from double monsters, may present difficulty even to experienced obstetricians. The diagnosis is then determined during the course of embryotomy, which, in such degrees of deformity, can seldom be avoided.

A special form of ventro-transverse presentation occurs in the mare resulting from bicornuate or transverse pregnancy. It is accompanied by a forward and lateral deviation of the uterus and its contents, and in addition may be associated with a ventral twisting of the uterus (rotated bicornual pregnancy—Williams). On internal examination the vagina is found to be considerably lengthened and containing no foetal parts, except perhaps one fore limb, but the foetus can be recognized through the vaginal wall. If the arm can be introduced far enough into the genital passage, a transverse, ventrally placed fold of mucous membrane is detected.

THE COW AND THE MARE

Mechanism of Correction and Delivery

As the great majority of cases of transverse presentation are protracted when first seen, with insufficient space in the uterus and a dry condition of the foetal integument, successful delivery can only be effected when the essential conditions necessary for rotation or turning of the foetal body into a direct presentation can be produced. These conditions are best obtained by the elimination of straining through epidural anaesthesia, and the infusion of linseed mucilage (10–15 litres) into the uterus. The introduction of the fluid into the most anterior (deepest) part of the uterine cavity is especially important for the correction of this presentation. By this means the uterine wall is raised from the dorsal surface of the foetus, with which it was previously in close contact, and the space necessary for movement is obtained. In this way the necessary conditions for successful correction are complied with—the anterior part of the foetus is enabled to glide and frictional resistance is avoided.

On the whole, this presentation is easier to correct than is dorso-transverse, because the extremities form suitable points of action for

evacuated with the foetus on delivery or removed from the uterus afterwards, if they have become detached.

This method of correction of ventro-transverse presentation, like that of "dog-sitting" position, has the following advantages: The pressure exerted on the forearms by the crutch, through the medium of the canvas cuffs, is transmitted to the upper arm and shoulder blade on each side, and consequently to the corresponding side of the thorax, because the joints of the limbs from the shoulder downwards are kept extended by the secure fixation of the digits to the crutch handle. Rotation at the point of action of the pressure—i.e. the thorax—takes place on an approximately perpendicular axis which passes through the two shoulder blades.

The operator is thus able, by means of a securely fixed crutch, to exert complete pressure displacement on the fore part of the foetus, in accordance with the laws of rotation, independently of whether the thorax and shoulder blade can be reached by the hand or not, and also to continue this pressure when the fore part of the foetus has become far removed from the pelvis. There is, therefore, no need to take precautions to prevent perforation of the uterus by the long fore limbs, especially those of the foal. After attaining the longitudinal position and removal of the crutch, the danger of injury to the uterus by the fore limbs is practically negligible.

Fixation of the crutch is such that slipping is practically excluded, providing the cuffs do not break.

Lastly, when the fore part lies nearer the pelvic inlet, turning into posterior presentation can also be effected by the crutch cuff method. In this case the degree of rotation must be more than 90 degrees.

The method described can also be employed when the head is not, as is usually the case, directed with the limbs towards the pelvis, but lies displaced in the uterus. In these cases it has proved to be the best method.

If, for various reasons, such as congenital curvature of the neck, or the hind parts of the foetus lie deeply in the uterus, rotation of the foetus at its anterior end is indicated, retropulsion of the hind parts by the crutch and cuffs (the latter being applied near the stifle joints) can be effected in the same way. In this case counter-traction is exerted on the fore limbs and head. These cases are more often encountered in the mare.

In the treatment of bicornuate pregnancy in the mare, it is necessary to reduce the kinking of the uterus by elevation of the maternal pelvis

spontaneously, in accordance with the law of rotation by two opposing forces.

After loosening the snares from the fore fetlocks (they can be left on

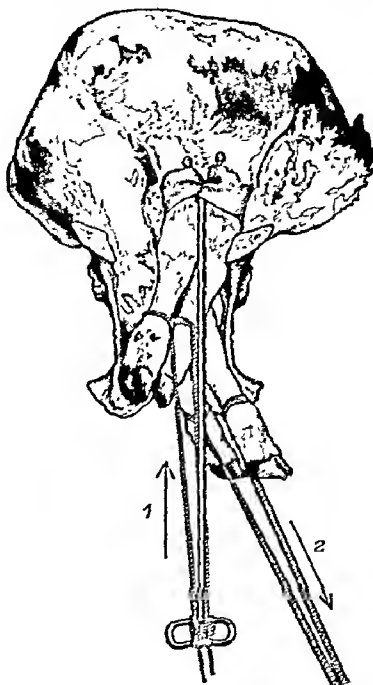


FIG. 143.—FIXATION OF THE CRUTCH ON THE FORE LIMBS FOR CORRECTION OF VENTRO-TRANSVERSE PRESENTATION.

just above the digits) and removal of the crutch, correction is completed by rotating the foetus into the dorsal position. It is then delivered in posterior presentation. The cuffs remaining on both forearms are either

CHAPTER 21

DELIVERY IN CASES OF MALFORMATION OF THE FŒTUS, AND IN OTHER FŒTAL DISEASES

THE obstetrician is concerned only with those forms of malformation and disease of the fœtus which give rise to dystocia. These may be of a number of different kinds.

THE COW AND THE MARE

Mechanism of Delivery

For the delivery of malformed or otherwise pathological fœtuses the predominant conditions existing in individual cases require much greater adaptation than those in a normally developed fœtus. The malformations encountered comprise monsters, including double monsters. In the latter case, if division cannot be effected, destruction of the mother is preferable to aimless attempts at embryotomy. If, after careful examination, it is decided that embryotomy offers some chance of success, it should be attempted in preference to delivery by forced traction.

In the present status of embryotomical technique, the delivery of a malformed fœtus by the use of excessive force, without at least previous partial amputation, should never be attempted. Nevertheless, experience shows that in some of the less pronounced degrees of fœtal deformity, especially when it is limited to certain parts of the body or when there is no marked disproportion between the size of the maternal pelvic cavity and that of the fœtus, delivery can sometimes be successfully effected without embryotomy. In such cases the rule of practice is as follows:

When the strongly flexed vertebral column of a moderately broad schistosomus reflexus lies in the pelvic cavity, an attempt may be made, after removal of the thoracic and abdominal viscera, to apply traction to the vertebral column by means of double hooks and cords passed around the trunk. In the same way delivery of a moderately developed schistosomus reflexus can be effected, when the head and all four extremities have entered the genital passage, by traction on the presented parts. In cases in which the halves of the body are unequally

or by complete raising of the hind quarters under general narcosis (intravenous chloral hydrate) or anterior epidural anæsthesia. If the head and fore limbs can be reached, correction and extraction can then, as a rule, be effected. If they cannot, the outlook is unfavourable. According to Jöhink, turning of the fœtus to posterior presentation is much more difficult. The indications for partial embryotomy will vary in individual cases.

Indications for Embryotomy. For reasons concerned with sufficiency of space and with the technique of rotation, the delivery of a fœtus impacted in transverse presentation in front of the pelvis can only be effected satisfactorily when the two fore limbs, with their shoulder blades, are separated from the thorax by subcutaneous or percutaneous amputation. The difficulties associated with complete removal of the lower-placed limb can be obviated by turning the mother into the corresponding position. Amputation at the elbow or shoulder joint may be sufficient, especially in the mare, but should, if possible, be performed generally with the finger knife, and only exceptionally with the wire saw embryotome, in order to avoid sharp bony projections on the stump which may prove dangerous during delivery. Amputation at the carpal joints is generally insufficient; moreover, on the grounds of operative technique, complete separation of the limbs with the shoulder blades is to be preferred whenever possible. Total or partial amputation of the hind limbs is only to be undertaken for reasons of expediency.

Delivery in Twin Pregnancy

When twins are born, one after the other, they seldom cause any difficulty, owing to the relatively small size of each fœtus, even when faulty conditions of posture, presentation, or position are present. In cases in which both fœtuses are presented simultaneously, it must be determined before commencing operation (1) to which fœtus a pair of limbs belongs, by palpation and flexion; (2) if there is a faulty presentation (ventral or vertical) of one fœtus only, or a malformed fœtus. The delivery of twins is effected as follows: Before extraction of the more advanced fœtus, the second, lying more deeply in the uterus, is repelled, generally by hand, but if it is impacted, by means of a crutch fixed by cuffs to the presented fore or hind limb.

Embryotomy is performed on the same lines as indicated for a single fœtus.

In dropsical conditions of the fœtus (anasarca, hydrothorax, ascites) the following rules should be regarded: By deep incision into the fœtus, evacuation of cystic swelling of the skin is effected, until the anterior part of the body (assuming the presentation to be anterior) is so approximated to the pelvic inlet that total embryotomy can be performed (amputation of both fore limbs, thoracotomy, exenteration and finally reduction of the size of the hind part of the body). It may be decided to use the vakufakt for the fragmentary removal of the vertebral column. When abnormal accumulations of fluid in the thoracic or abdominal cavities constitute an obstruction to delivery, these cavities must be opened in the usual way.

The dangers associated with delivery of a double-headed fœtus can be obviated by successive amputation of each head, using a saw embryotome.

The operative treatment of hydrocephalus consists in reduction of the size of the cranium. If the membranous portion forms the chief obstruction, it is generally sufficient to incise the highest point of the fluctuating swelling. Reduction of the size of the cranium will then allow entry of the head into the pelvis, and delivery by means of eye hooks. If the obstruction is due to the bony cranium itself, this must be sawn through, and the sawn surface covered by a towel during extraction.

Obstruction caused by congenital curvature of the cervical vertebræ is most easily overcome by division of the neck, using the chain or wire saw, or by Pfanz's embryotome.

In deformities of the extremities (contractions and ankyloses) amputation performed on general principles is best, section being made at the carpal or tarsal joints respectively, with the wire saw embryotome. It should be undertaken as soon as rigidity is detected, for futile attempts at extension not only fatigue the operator, but are dangerous to the mother.

advanced, delivery can often be attained by twisting the fœtus by force applied to those parts of it outside the vulva.

Delivery in cases of chondrodystrophia congenita (bulldog or otter calf), without operative interference, is only to be considered when the maternal pelvic conditions are favourable and the width of the fœtal trunk is not excessive.

Extraction of a case of simple fissura abdominalis presents no serious difficulty, as a rule, after removal of the prolapsed viscera.

Cases of peresomus elumbus are not more difficult than that of schistosomus, provided that the anterior part of the body is not abnormally large or the fore limbs are not markedly contracted and ankylosed.

A fœtus with congenital curvature of the neck, often associated with malformation of the head (the curvature of the skull usually corresponds to the convex curvature of the vertebral column), and also with shortening of the extensor or flexor tendons, so that the digital joints are at right angles to the metacarpus, is relatively common in the mare. Delivery by forced traction on the fore limbs, without previous division of the neck, may be carried out satisfactorily, but only when the fœtus is small and the pelvic space in the mother sufficiently roomy. In all other cases embryotomy is indicated from the outset.

Delivery of fœtus with a double head, double face, hydrocephalus, or tumours of the neck can only be effected without previous embryotomy when the width of the genital canal is sufficient to allow its passage.

Indications for Embryotomy. The multiplicity of the malformations in the calf and foal, and the differences with regard to presentation, position and posture in each individual case render it difficult to formulate any general rules. However, the result, at least in certain forms of malformation, can often be favourably influenced by adopting certain principles.

In the case of schistosomus reflexus typical methods of operating are: (1) Halving the body with the chain or wire saw at the most prominent part of the convexity of the vertebral column, when the extremities lie towards the uterus; or (2) removal of the fore limbs with the shoulder blades (sub- or percutaneously) when the fœtus is presented by all four limbs. Limb contraction or ankylosis of the joints, and also oblique presentation of the deformed fœtus, require special treatment adapted to the conditions prevailing. In any case, amputation of the limbs, so performed that sharp bony stumps are left on the trunk, is to be avoided as far as possible.

CHAPTER 22

EMBRYOTOMY

EMBRYOTOMY comprises all operations on the *fœtus*, performed within the body of the mother, for the purpose of reducing its size by the division of certain of its parts. The term *partial embryotomy* is applied when division of a single part of the *fœtal* body is sufficient to overcome the obstruction to delivery, and the term *total embryotomy* when the *fœtal* body has to be divided into several parts, usually extending from one end to the other.

Partial embryotomy is usually performed when the size of the *fœtus*, in comparison with that of the mother, is normal, and the genital canal is of normal width. Total embryotomy is most often required when the *fœtus* is of abnormally large size or presents certain pathological changes, and less often in abnormally narrow conditions of the maternal genital canal.

Partial embryotomy may be performed with the object either of obtaining sufficient space for the correction of a faulty posture, presentation, or position which constitutes an obstruction to actual delivery, or for the removal of a direct obstruction.

Technically, the different methods of dismemberment of the *fœtus* fall into two groups—the *subcutaneous* and the *percutaneous*, according to whether the skin of the part to be separated is retained or not. In the *subcutaneous* method, therefore, the actual amputation of the part in question, usually a limb, must be preceded by removal of the skin, and after sufficient division of muscular and articular attachments to the trunk, the limb is "drawn through the skin." The advantages of the *subcutaneous* method—i.e., protection of the uterine wall by the skin against injury from the use of instruments, and the maintenance of a firm point of action for subsequent traction—are counteracted by its disadvantages. The operation takes much longer to perform and may lead to contusion of the genital passage. The advantages of the *percutaneous* method—the possibility of a rapid, definite and impressive operation—are not always attainable in practice on account of the expensive and elaborate equipment required. In addition, experience and rational methods are essential if the mother is to be safeguarded.

General Directions

1. Embryotomy should never be delayed too long, and therefore when attempts at correction and traction offer little prospect of success, they should be abandoned early. Successful results can only be obtained when the selected operation is adapted to each individual case. It must be decided first of all whether the subcutaneous or the percutaneous method is the more likely to succeed, and whether the prospects of a satisfactory result are better with a partial or with a total embryotomy. As a rule, in the mare partial embryotomy will be found sufficient.

2. Before commencing dismemberment of the fœtus it is necessary to formulate a plan of operation in accordance with the existing conditions, but one which can be modified as occasion demands. In some cases the necessity for carrying out total embryotomy or the dismemberment of malformations may not be discovered until the operation is in progress.

3. Experience shows that the mare is more sensitive to extensive embryotomy than is the cow, and thus, on principle, dismemberment of the fœtus in the mare should not be commenced until manipulative methods of correction have failed. An exception to this rule is in the case of an extremely emphysematous fœtus. Even in certain faulty postures, such as lateral displacement of the head and nape posture, and abnormal presentations, such as ventro-vertical, which necessitate embryotomy in the cow when attempts at correction have failed, in the mare, under certain favourable conditions, forcible extraction is not only legitimate but sometimes even preferable to embryotomy, especially when the conditions present render any dismemberment according to plan impossible.

4. The present status of obstetrical technique admits of all surgical interference being carried out without causing suffering to the mother. It is the imperative duty of the obstetrician to adopt this humanitarian attitude and carry out all embryotomy under appropriate anæsthesia. Again, by the elimination or reduction of straining the most suitable operative technique can be used as required. Of the various methods of anæsthesia available, epidural injection is to be preferred to all others in the cow and mare, on account of the simplicity of induction and its absolute safety. It is only in exceptional cases—restless or vicious animals—that general narcosis comes under consideration, and of the methods in use, chloral hydrate, per os or intravenously, is the best.

5. Sufficiently complete anæsthesia of the hind quarters usually

CHAPTER 22

EMBRYOTOMY

EMBRYOTOMY comprises all operations on the *fœtus*, performed within the body of the mother, for the purpose of reducing its size by the division of certain of its parts. The term *partial embryotomy* is applied when division of a single part of the *fœtal* body is sufficient to overcome the obstruction to delivery, and the term *total embryotomy* when the *fœtal* body has to be divided into several parts, usually extending from one end to the other.

Partial embryotomy is usually performed when the size of the *fœtus* in comparison with that of the mother, is normal, and the genital canal is of normal width. Total embryotomy is most often required when the *fœtus* is of abnormally large size or presents certain pathological changes, and less often in abnormally narrow conditions of the maternal genital canal.

Partial embryotomy may be performed with the object either of obtaining sufficient space for the correction of a faulty posture, presentation, or position which constitutes an obstruction to actual delivery, or for the removal of a direct obstruction.

Technically, the different methods of dismemberment of the *fœtus* fall into two groups—the subcutaneous and the percutaneous, according to whether the skin of the part to be separated is retained or not. In the subcutaneous method, therefore, the actual amputation of the part in question, usually a limb, must be preceded by removal of the skin, and after sufficient division of muscular and articular attachments to the trunk, the limb is “drawn through the skin.” The advantages of the subcutaneous method—i.e., protection of the uterine wall by the skin against injury from the use of instruments, and the maintenance of a firm point of action for subsequent traction—are counteracted by its disadvantages. The operation takes much longer to perform and may lead to contusion of the genital passage. The advantages of the percutaneous method—the possibility of a rapid, definite and impressive operation—are not always attainable in practice on account of the expensive and elaborate equipment required. In addition, experience and rational methods are essential if the mother is to be safeguarded.

CHAPTER 23

INSTRUMENTAL EQUIPMENT FOR EMBRYOTOMY

IN the present state of our knowledge of embryotomy in the cow and mare, a comparatively small number of instruments will be found quite sufficient to serve all purposes. This is especially the case when the operator is familiar with the use of the wire saw embryotome. At present, however, there is no agreement in veterinary circles as to which of the recently devised sawing or perforating instruments is the best, nor to which the term "universal instrument" is applicable, if such a designation should be used at all.

The following description applies chiefly to the most recently introduced equipment. When older instruments, which are still useful for certain purposes, are referred to, they are introduced for the purpose of instructing the beginner that under certain conditions the object in view can be attained by simple, practical and adaptable methods. Lastly, the selection has been made as the result of the author's personal experience, and that of his assistants, in the course of eighteen years.

FINGER KNIVES AND HAND EMBRYOTOMES

For incisions in the skin and muscles three types of knife are employed: Günther's finger knife modified by Tapken with a hooked cut-



FIG. 144.—GÜNTHER'S FINGER KNIFE
MODIFIED BY TAPKEN.

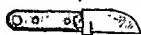


FIG. 144A.—VENNERHOLM'S
EMBRYOTOME.

ting edge (both rings must be larger than the width of the operator's finger), Vennerholm's embryotome (Fig. 144A) and Möller's embryotome (with five exchangeable blades).

SPATULÆ

For subcutaneous embryotomy, both in the extended and in the completely flexed positions of the limbs, Keller's semi-sharp, indivisible spatula has been found the most serviceable instrument (Fig. 145). It is

makes it necessary for operative procedures to be performed with the animal in the recumbent position, but this is by no means a disadvantage if the hind parts are raised. On the contrary, with the mare or cow recumbent under deep regional anaesthesia, the relaxation of the genital passage provides greater facility for the manipulation of instruments than when the animal is in the erect position and the force of abdominal pressure has to be counteracted.

6. Embryotomy is contra-indicated while the foetus is still alive. Its death may be brought about, in anterior presentation, by penetration of the brain, using a metal rod passed through the naso-pharynx, or by cutting the carotid artery or puncture of the thorax; and in posterior and breech presentations, by laceration or rupture of the umbilical cord.

7. When removal of a limb is to be performed subcutaneously in a recently dead foetus, separation of the skin should be preceded by the induction of artificial emphysema in the field of operation, by the subcutaneous injection of air, using a hypodermic needle and air pump.

8. It should be kept in mind from the beginning until the end of embryotomy, that the owner expects a favourable result as regards the mother, and once embryotomy is commenced it must be completed. It is therefore advisable, before starting, to decide whether the equipment to hand and also the operator's experience are sufficient for the complete accomplishment of the task, or whether special instrument or a consultation with a colleague are necessary.

9. Before commencing operation it is necessary to determine, by careful examination, whether the genital passage has already been severely injured, especially by lay interference. If, owing to impaction of the foetus, this cannot be decided, the possibility of such injury should be reported to the owner before commencing.

10. If the general condition of the animal or the results of local examination reveal that there is little prospect of a successful result, all attempts at embryotomy should be abandoned and destruction of the animal recommended. A fruitless attempt at embryotomy to save the life of the mother is valueless to the owner and derogatory to the obstetrician.

the limbs at certain joints. Persson's chain saw and Pflanz's embryotome, with its strong chain knife, may be used for the same purposes,



FIG. 146.—REINFORCED MASCH'S CHAIN KNIFE, VIENNA MODEL.

especially for cutting through bone, but Persson's instrument is liable to become fixed when dividing long bones transversely. In Peterson's



FIG. 146A.—PERSSON'S CHAIN SAW.

model the rods of the embryotome are covered by a tube to prevent injury to the vagina.

MANUAL WIRE SAWS

The original wire saws of van Staa and Ehlers, without tubular or spiral protections, have now been superseded by the wire saw embryotome.

WIRE SAW TUBULAR EMBRYOTOMES

1. Thygesen's Embryotome (Fig. 147) consists of two metal tubes 70 cm. (28 inches) long, firmly fixed together. The anterior end of each tube carries a perforated, rounded head, made of the hardest steel.

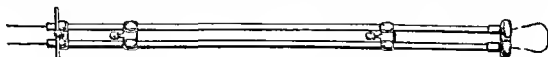


FIG. 147.—THYGESEN'S EMBRYOTOME.

The heads are connected with each other and with the tubes, making the total length of the instrument 73 cm. (29½ inches). The tubes are connected by three transverse bridges to give the instrument rigidity, and the posterior one carries a detachable handle. A steel wire saw is used in this and all other tubular embryotomes.

especially useful for decortication of the limb and subsequent division of the muscles attaching it to the trunk. It is controlled by the other



FIG. 145.—KELLER'S SEMI-SHARP SPATULA.

hand lying outside the skin. It is advantageous, but not indispensable, to use Bruin's short spatula for making the initial pocket, and the decorticating knife for prolonging the skin incisions.

The end of the blade is blunt and flattened transversely, somewhat resembling a duck's beak in shape. The cutting edge of the knife is protected by a metal guard, which is attached by two small screws to the handle. When the guard is fixed there is an aperture of about 2 mm. between it and the blade. The instrument is most useful for subcutaneous amputation of a fore limb. A small incision is made with an ordinary



FIG. 145A.—CHARLES ROBERTS' EMBRYOTOMY KNIFE.

scalpel on the lateral aspect of the fetlock. Into this incision the beak of the knife is inserted. Having tensed the limb, the knife is steadily pushed forwards, cutting the skin as it goes, until the region of the cartilage of the scapula is reached. The advantages of this knife over the hooked knife are: The operation is easier and the skin is cut to an even depth throughout. Decortication of the limb is carried out with the fingers assisted by the beak of the knife. The muscles and other structures in the axilla can also be easily cut by forcing them between the knife and its guard. The guard renders the instrument a perfectly safe one.

CHAIN KNIFE AND CHAIN SAW

At the author's clinic a reinforced instrument 50 cm. (20 inches) long, similar to Lindhorst's chain knife, is employed for division of the skin and soft parts in the direction of traction (Fig. 146). It is also used for longitudinal division of the vertebral column—e.g. after operative removal of the trunk up to the lumbar vertebræ, and for amputation of

Bergsma's embryotome is a modification of Neubarth's instrument, with a single tube, and a single central canal in the head.

3. **The Hannover Modification of Thygesen's Embryotome** (Fig. 150). This consists of two thin steel tubes, 90 cm. (36 inches) long, each carrying a centrally perforated, rounded hard steel head 2.5 cm. (1½ inches) in diameter. During the operation of sawing the tubes are firmly fixed together by a movable rod, fitted with two cross-clips. The



FIG. 150.—HANNOVER MODIFICATION OF THYGESSEN'S EMBRYOTOME (LIES' MODEL):
LISS' BALL GRIPS AND THREADING SOUND.

lower of these carries a large screw which serves both for fixing the connecting rod and as a handle. This arrangement facilitates: (1) the application of the wire loop to that part of the foetus to be removed, when employing angular sawing; (2) the introduction of the tubes unconnected, but lying close together, and subsequent fixation when in position (an advantage especially for transverse division of the foetus); (3) amputation in the axis of traction, for the wire can be drawn around the part to be removed by means of the loop introducer and subsequent fixation of the two tubes.

For fixation of the embryotome to the body of the foetus Lappe has devised a special head plate carrying sharp eye hooks. A single or divided threading sound, which also serves as a cleaning rod, and two ball grips, which also serve as introducers, complete the equipment of the instrument.

Any form of forward sawing, by diverting the direction of the tubes, is, in the author's experience, unsatisfactory, and consequently a description of the method and of the fixation claw employed when it is attempted, is considered unnecessary.

4. **Other Forms of Wire Saw Tubular Embryotomes.** In Eikelenboom's "Prinophore" sawing is performed through tubes which are movable, but connected posteriorly by a joint. By this means the tubes can be set at an angle and partly enclose the foetal part.

Thunberg's fixation embryotome possesses the advantages that it can be better adapted to different cases, that friction of the saw is reduced, and that the wire can be changed without removal of the instrument from the vagina.

As a grip for sawing, Thygesen uses a small, perforated metal handle, with a screw attachment for securing the wire, but other types of handle, in which the wire is held between broad metal plates, have proved more useful, because they avoid the possibility of injury occurring through the wire kinking (those of Simon, Schebitz, Liess—Fig. 149).

2. Neubarth's Fœtotome (modified by Benesch) (Fig. 148). This comprises a single metal tube, 75 cm. (30 inches) long, made in two parts,

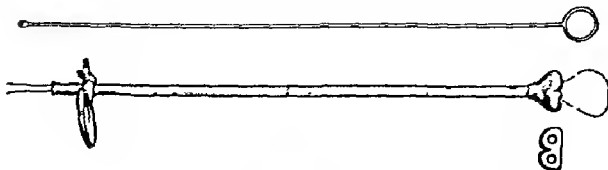


FIG. 148.—NEUBARTH'S FŒTOTOME, MODIFIED BY BENESCH, WITH THREADING SOUND.

and connected by a screw joint. The hard steel head is perforated by two funnel-shaped canals, the orifices of which have rounded edges. The head is screwed on to the shaft. The total length of the instrument, with the head, is 80 cm. (32 inches). To reduce the diameter of the head, one side is flattened, and when using the instrument for angle cutting the flat surface must be directed away from the skin. The free end of the tube is divided into two halves by a movable, ring-shaped, metal plug

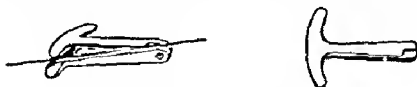


FIG. 149.—SIMON'S HANDLE FOR WIRE SAW.

with a cross-pin. The pin is always placed at right angles to the flat side of the head. The object of the division is to prevent crossing of the wires during introduction with the threading sound. The latter is especially liable to occur when employing wire which has been previously used and has become twisted. It also serves to prevent crossing of the wires during pauses in sawing. During introduction of the free shank of the wire, the one already lying in the opposite division of the tube should be drawn taut. As a handle the author employs Simon's saw grip (Fig. 149). The instrument is held in position by an adjustable clamp.

ordinary pin loop. The roller embryotome can be used for dismemberment of the foetus both in anterior and posterior presentations. Sawing at angles of approximately 180 to 60 degrees to the line of traction can be effected, whilst direct sawing can be employed by the addition of Glättli's spiral tubes (Fig. 151A).

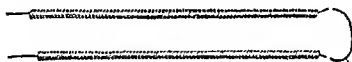


FIG. 151A.—GLÄTTLI'S SPIRAL TUBES.

Reetz describes the use of the instrument as follows: The saw is to be tensed to its limit by retention of the yielding shank, and firm traction on the part of the foetus to be amputated. Sawing is performed with the upper part of the body inclined backwards (the position of a discus thrower) and traction executed with lateral movements of the shoulders. Short pauses are made during section through bones, whilst care must be taken, during final division of the last bridge of skin, that the saw does not form an acute angle. This can be prevented by pressing the skin against the saw with the hand, or, when Glättli's spiral tubes are being used, by inserting a linen pad between their anterior ends and the skin, thus providing a greater radius of curvature. It may be decided to divide this last bridge of skin with the finger knife. The duration of the operation is considerably shortened, and the wire spared, by a preliminary incision of the skin in the correct place, before applying the saw.

BAHLKE'S MODIFIED EMBRYOTOME (AFTER MEYER-SCHLICHTING)

This instrument consists of a metal plate with rounded ends 13 cm. ($5\frac{1}{4}$ inches) long and 5.5 cm. ($2\frac{1}{4}$ inches) wide (Fig. 152). To one surface is attached a stout hook, for fixing the instrument to the foetus, and on the other are two flanged plates. The upper of these is circular, and the lower semicircular carrying an eccentric arm. The upper, circular, flanged plate serves for fixing the upper spiral tube of the saw (it is fitted with a screw for the purpose), whilst the lower spiral tube is fixed between the two plates. The eccentric arm is perforated for the attachment of a snare, by which it is possible to apply the necessary tension. The instrument is introduced by means of a detachable, flexible steel rod 80 cm. (32 inches) long, with handle. The two spiral tubes can be fixed with their orifices directed to the same side, either right or left, or to opposite sides. The wire saw employed may be of four-strand

For passing the wire loop over parts of the foetus difficult to reach by hand, various introducers have been recommended, but as a rule they are unnecessary.

The Technique of the Wire Saw Tubular Embryotome

In all these instruments the saw comprises twisted steel wire. Generally the wire employed is made of four strands and is 6 to 10 metres long, but sometimes wire of a stronger texture is used. Kinking of the wire during operation may occur with either form, but it is more common with the finer than with the stouter wire. On the other hand, the latter less readily cuts the skin. It is important that kinking of the wires during operation shall be avoided. The operation of sawing is performed from the shoulders, using the weight of the body, rather than from the arms alone. At first—that is, during division of the skin—rapid strokes are employed, but afterwards long and forcible (not violent) ones. Short intervals of rest are taken, when the assistant may be changed, but during these pauses tension must be maintained on the wire to prevent kinking and twisting.

Sawing through loose skin is difficult, and thus the part to be removed should be well stretched. This may be facilitated by the use of double hooks.

REETZ'S WIRE SAW ROLLER EMBRYOTOME

Fixation of this instrument to the skin of the foetus, and protection during sawing, are effected by means of a roller guide. It consists of a German silver cover for the saw, 5 cm. (2 inches) wide and 90 cm. (36 inches) long (Fig. 151). The anterior end is slightly deeper, and



FIG. 151.—REETZ ROLLER EMBRYOTOME.

carries two hooks for fixing it to the foetus. The hooks can be sheathed or exposed by means of a rod. Behind the hooks are the rollers for the wire saw. The posterior end carries spring eyelets through which the wires are threaded. The most suitable wire for this embryotome is that introduced by Reetz, 3-5 metres long and made of two or four strands (R_2 and R_4 saws). Wooden handles for working are attached by an

thickness or stouter. The latter has less tendency to twist, but does not so readily cut through the skin. Also it soon becomes smooth.

Bahlke adopts a special introducer for the saw, but the ordinary introducers, such as Schriever's, are equally suitable. As grips for the wire, either Meyer-Schlichting's ring-shaped handle (with this the wires and the spiral tubes are fixed simultaneously), Schebit's (Fig. 153), or Simon's handles, can be used. When using the wire saw with the protective spiral tubes alone, in direct or approximately direct sawing, the Meyer-Schlichting's holder (Fig. 152, *b*) is suitable, for it fixes the ends of the tubes and protects the hands when the tubes become hot.

The technical details of sawing are fundamentally the same as with tubular or roller embryotomes.

In order to spare the wire, a preliminary skin incision at the appropriate site may be made with a finger knife, and, again, the final division of the skin may be carried out with the knife, to avoid acute-angled kinking of the saw.

HENNING'S EMBRYOTOME

A simple and comparatively inexpensive instrument has been introduced by Henning, which includes certain features of both the Meyer-Schlichting and Danish types. It comprises an irregularly triangular

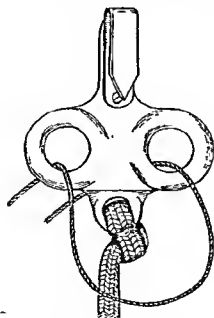


FIG. 153A.—HENNING'S EMBRYOTOME.

metal plate, with rounded edges, perforated by three holes. The anterior pair serve for the passage of the wire saw and the posterior one for the attachment of a snare. It carries a hook for fixation to the fœtus. The

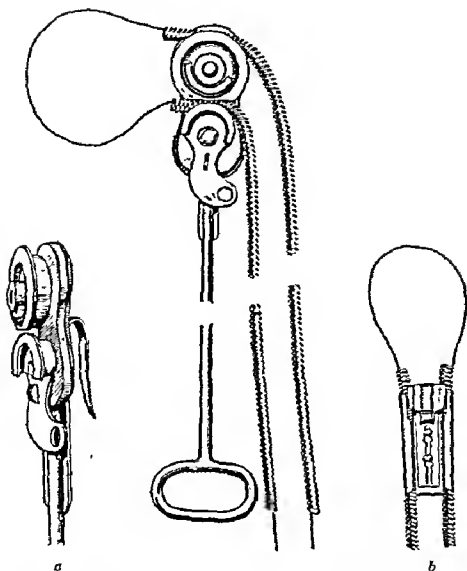


FIG. 152.—BAHLKE'S MODIFICATION OF MEYER-SCHLICHTING'S EMBRYOTOME, WITH WIRE SAW AND SPIRAL TUBES FIXED ON ONE SIDE.

a, Lateral view of the head with flanged plates and hook; *b*, holder with spiral tubes inserted.

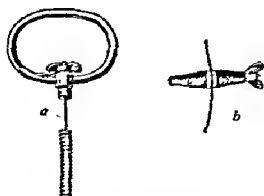


FIG. 153.—WIRE SAW GRIPS.

a, Meyer-Schlichting's (which may also be used as introducers); *b*, Schebitz.

of the two joints, in front of and behind the spiral saw, is to prevent the latter passing through the wall of the spinal canal in cases in which there is curvature of the vertebral column. A lever 35 cm. (15 inches) long,

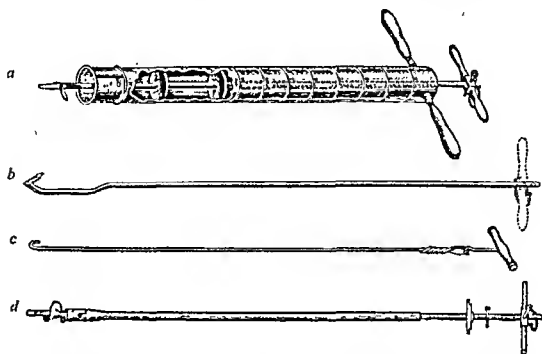


FIG. 154.

- a*, The Becker-Schüttler vakufakt with guiding rod carrying jointed knife and bearings; *b*, harpoon hook for posterior and breech presentations; *c*, wire hook for prolonging the guiding rod; *d*, spiral saw with terminal joints (substituting the guiding rod with jointed knife), with lever and bolt.

fitted to the hinder end of this rod, serves to rotate the spiral saw into the spinal canal, whilst by means of a bolt, forward movement of the saw can be blocked, and the vertebral column broken at the desired point.

instrument would appear to be useful for transverse amputation, especially of structures already lying in the vagina, such as the head and neck, or limbs. Henning himself (*Tierarztl. Rdschau*, 1936, 42, 306) describes its method of employment in breech presentation.

STUVEN'S RACHIOPHORE *

This was the first instrument to be invented having as its principle destruction of the foetal vertebral column and its surrounding tissues, so that the width of the foetus, when stretched, became so reduced that it could be delivered in the extended position. It is suitable in cases of absolute oversize in the calf and may also be used in breech presentation after destruction of the foetal pelvis.

The instrument consists of a metal tube, the anterior end of which comprises a drill, and in its lumen, the rachiphore rod and spinascope are introduced. The spinascope serves to determine the presentation of the foetus, whilst the rod, introduced into the vertebral canal, fixes the instrument.

THE VAKUFAKT (BECKER-SCHOTTLER) *

The principal object of the "evacuator" is not to destroy the vertebral column itself, but to saw around it, so that it can be removed completely. The instrument is especially suitable in cases of abnormally large calf, presented anteriorly. In posterior presentation and in certain malpostures it should only be used with the aid of harpoon-shaped hooks. The instrument (Fig. 154) consists of: (1) A metal tube 70 cm. (28 inches) long with a trephine, protected by a sheath, at its anterior end, and handles for screwing at the other. (2) A guiding rod, with a small folding knife at the head end and with a detachable handle at the other, and an eyelet to which a prolongation rod may be attached. (3) A number of plate-like bearings for the guiding rod.

A long wire hook is provided which, when attached, serves to lengthen the guiding rod. Another rod, carrying a harpoon hook at its anterior end, replaces the guiding rod when the instrument is being used in posterior and breech presentations, and in certain faulty positions, such as dorso-transverse, and also in abnormal postures, such as lateral deviation of the head and breast-head posture. More recently Becker has replaced the guiding rod carrying the folding knife by one fitted with a jointed spiral saw, for destruction of the vertebral column. The object

* It is improbable that English readers will be familiar with these instruments.
—J. G. W.

dissected away from the region of the occipito-atlantal joint, and after severing the muscles and ligaments the joint is disarticulated. The head is finally removed after dividing the muscular and subcutaneous connections. The three flaps of skin remaining (the two ear flaps and the mandibular flap) are incised to receive short wooden rods, which serve for the attachment of traction snares.

2. By the Wire Saw Tubular Embryotome. This method is usually employed when the head is situated in the vagina. The wire loop projecting from the head of the instrument is passed over the fetal head. The instrument itself may be placed on the dorsal, ventral or lateral aspects of the neck, according to which is the most convenient in the

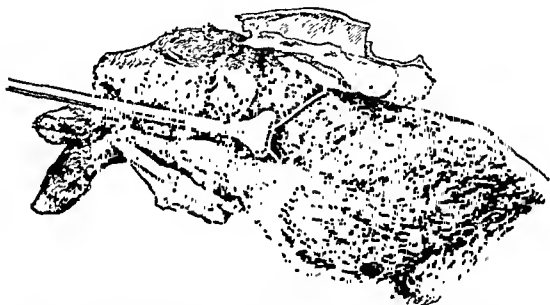


FIG. 156.—AMPUTATION OF THE HEAD, USING THE MODIFIED NEUBARTH'S FÆTOTOME. The application of the other tubular embryotomes is similar. During sawing the head is extended. Amputation of the head with the whole of the neck can be effected by suitably fixing the instrument against the withers.

space available. When employing the modified Neubarth's fœtotome, the curved side of the head of the instrument is directed against the skin (Fig. 156).

When using the Hannover instrument, any difficulty in passing the wire loop over the head may be overcome in the following way: Both tubes lying free and close together, with the wire threaded through them, are introduced into the mandibular space. While one tube is held stationary in this position, the other is passed over the occiput and around the head, carrying the wire saw with it, until it regains the mandibular space. In this way the neck is snared. The tubes are then fixed by applying the fixation rod from the free ends. For amputation of the

CHAPTER 24

METHODS OF REMOVING THE EXTENDED HEAD OR AN EXTENDED LIMB, EITHER ENGAGED IN THE PELVIS OR DISENGAGED

A. AMPUTATION OF THE HEAD

1. **Drahn-Lindhorst's Method** (Fig. 155).—This method is only applicable when the head is already outside the vulva. It is indicated when it is wished to preserve the skin for subsequent traction, as in the case of an

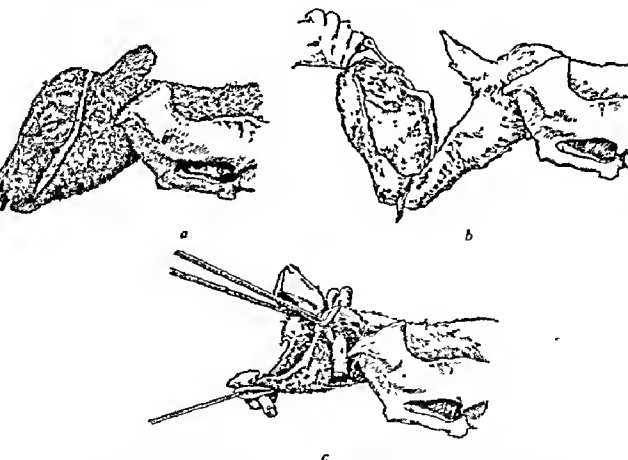


FIG. 155.—AMPUTATION OF THE HEAD OUTSIDE THE VULVA BY DRAHN-LINDHORST'S METHOD (*a* and *b*), AND THE FIXING OF SHORT WOODEN RODS WITH SNARES FOR APPLYING TRACTION (*c*).

emphysematous foetus, or one in which there is marked friction resistance to delivery. Two symmetrical incisions are made, extending from the occiput in front of the ear to the angle of the mouth. The skin is

is fixed between the shoulder blades. During sawing the head and neck must be held tense.

(b) Without the hook plate, but with the spirals secured in the "holder" (Fig. 157A). The spiral tubes, enclosed in the holder, lie in

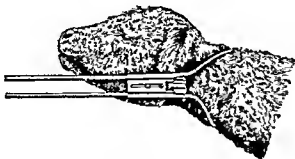


FIG. 157A.—AMPUTATION, USING THE "HOLDER," WHICH ENCLOSES THE SPIRAL TUBES.
The spiral tubes serve to protect both the vagina and the wire saw.

the mandibular space, or on the side of the head, and are held in this position by hand during sawing.

5. In cases in which there is dorsal deviation of the head, division of the neck can be effected either with the wire or chain saw. The head must be fixed previously by means of a mandibular snare or hooks applied near the angle of the jaw. When employing the simple wire saw, Glättli's spiral tubes may be used for protection of the vagina.

B. COMPLETE AMPUTATION OF A FORE LIMB IN THE NORMAL, EXTENDED POSITION

Subcutaneous Methods

These methods can only be carried out successfully when the limb to be amputated projects from the vulva as far as the mid-metacarpal region. When the other limb is presented simultaneously, its replacement in the uterus, after flexion of its joints, considerably facilitates the operation, by providing more space.

1. By the Keller-Benesch Modification of de Bruin's Method (Fig. 158). Skin incisions are made on the mesial and lateral aspects of the leg, extending from the carpus to below the fetlock joint. The limb is fixed by a snare above the fetlock, and held extended.

Prior to the application of the snare, the skin around the fetlock and metacarpus is separated, by dissection, from the underlying structures. Keller's semi-sharp spatula is introduced subcutaneously, and the skin

head, together with the neck, the loop is applied nearer to the shoulders, whilst the head of the embryotome is held on the withers. To prevent the instrument slipping back during sawing, its hinder end must be securely fixed to the head by a cord. In some cases the head of the instrument can be held in position by the hand.

3. Using the Roller Embryotome of Reetz. After passing the wire loop over the head of the foetus, the instrument is introduced into the mandibular space, or to the side of the neck, and fixed by engaging the hooks in the skin. The line of sawing is approximately at right angles to the line of traction. When amputating the head with the neck, the hooks are applied to the withers.

4. Amputation at the Neck, using the Meyer-Schlichting Embryotome. This can be employed in two ways:

(a) By means of the hook plate. The spiral tubes are fixed to the plate with their ends in the same direction and projecting 1 to 1.5 cm.

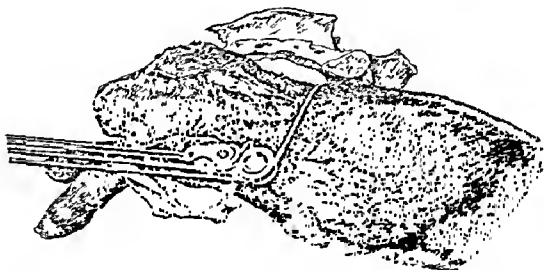


FIG. 157.—AMPUTATION OF THE EXTENDED HEAD WITH THE MEYER-SCHLICHTING EMBRYOTOME.

The plate is fixed by the hook to the skin of the forearm. Fixation may also be applied nearer to the carpus or to the shoulder region. When fixed at the withers, the spiral tubes must face in opposite directions.

($\frac{1}{4}$ – $\frac{1}{2}$ inch). The wire loop is completed. The loop is passed over the foetal head, and the plate fixed by engaging the hook, either to the side of the neck or, when the fore limbs are strongly engaged in the pelvis, to the skin of the forearm (Fig. 157). The hook remains fixed during sawing, by strong traction on the rod (or snare in the case of the original instrument). When amputating the head and neck together, the spiral tubes are fixed on opposite sides of the plate, and the hook

using the finger knife, dissecting knife, or Vennersholm's knife,* and any subcutaneous connections remaining are broken down with the fingers. When the work with the spatula has been thoroughly carried out it becomes unnecessary to use the finger knife for dividing the muscular connections.



FIG. 159.—SUBCUTANEOUS AMPUTATION OF THE EXTENDED FORE LIMB.

Stage II.—After disarticulation of the fetlock joint the limb is removed "through the skin." The preservation of the digits with the skin serves for the effective attachment of the traction cord.

The fetlock joint is next disarticulated without severing the skin, and a traction snare applied to the distal end of the metacarpal bone. By the application of uniformly increasing traction the decorticated limb

* Charles Robert's knife (Fig. 145A) is most suitable for this purpose.—J. G. W.

separated on the mesial aspect of the leg as far as the axilla, and on the lateral to the cartilage of prolongation of the scapula. This is followed by division of the muscles connecting the scapula to the thorax and back

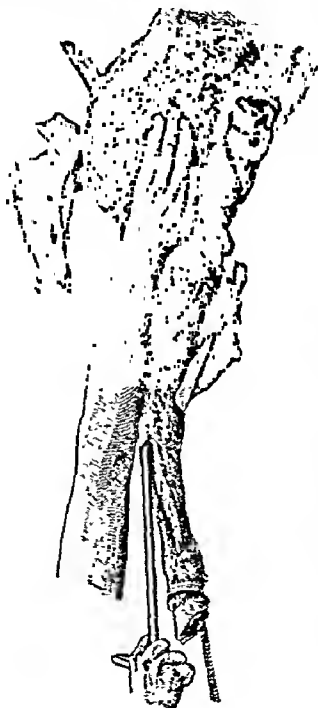


FIG. 158.—SUBCUTANEOUS AMPUTATION OF AN EXTENDED FORE LIMB IN A CASE OF LATERAL DISPLACEMENT OF THE HEAD.

The other fore limb has been flexed and replaced in the uterus to provide more space. Stage 1.—Separation of the skin, employing Keller's spatula, and using the other hand to control it.

(deltoid, trapezius, serratus magnus, superficial and deep pectorals, and the brachio-cephalicus), together with the vessels and nerve trunks. The mesial skin incision is then completed up to the axillary region,

2. Zwick's Method (Fig. 160). Two deep incisions are made at the superior and inferior angles of the cartilage of the scapula, and between them, by means of the index finger, a canal is made under the scapula. Using a snare introducer (Zwick's or Lindhorst's), the chain saw, wire



FIG. 160.—AMPUTATION OF THE FREE FORE LIMB IN LATERAL DISPLACEMENT OF THE HEAD, BY ZWICK'S METHOD, USING A CHAIN KNIFE.
The chain knife is passed beneath the scapula by means of a Zwick's snare introducer or Lindhorst's guiding ring.

saw, or chain knife is passed through the canal, and by sawing the skin and other structures the limb is for the greater part separated from the thorax. Complete separation of the skin and muscles lying on top of the cartilage of the scapula is effected with the finger knife. In this

is detached from the thorax and removed. The digits, still attached to the skin, serve as a point of fixation for a traction cord in the final delivery of the fœtus.

2. Using the Modified Pflanz Extractor (Vienna Model).^{*}—With a finger knife a longitudinal skin incision is made from the centre of the inner aspect of the

By means of a crank the ring is driven subcutaneously up the limb until it has reached the shoulder joint. As the ring is passing through the vulva care must be taken to

removed without crushing the maternal passage. As the extractor is made of flexible material it must be secured to the limb by a cord during operation, to prevent its bending.

instrument.

Its disadvantage is that its use is limited to removal of extended limbs.

Percutaneous Methods

As was the case in subcutaneous methods, replacement of the second limb into the uterus facilitates removal of an extended limb by percutaneous methods.

Amongst the older, but still useful, methods are the following:

1. The Albrecht-Lindhorst Method. An incision is made between the cartilage of the scapula and the thorax, using a finger knife, and into this the chain saw or wire saw is inserted. During the operation of sawing the limb is drawn tense and abducted. If, with the limb extended, the site for making the incision cannot be reached, it can usually be effected after repelling the limb into a state of shoulder flexion posture (p. 299).

^{*} For details of the construction and illustrations of this instrument see *Tierärztliches Archiv (Prager Archiv)*, 1922.

(b) By nearly direct or obtuse-angled sawing (Fig. 162). By this method the limb can be severed from the thorax with the least demands



FIG. 162.—AMPUTATION OF THE LEFT FORE LIMB (THE HEAD OF THE FOAL IS DISPLACED TO THE RIGHT) BY OBTUSE-ANGLED (APPROXIMATELY DIRECT) SAWING WITH THE FETOTOME.
This requires a deep incision (with the finger knife or Vennerholm's knife) between the cartilage of the scapula and the thoracic wall to receive the loop of the wire saw.

on the wire saw, and without the danger of sawing through the scapula. A deep incision is made just beyond the cartilage of the scapula, through the skin and muscles. If limitations of space make this difficult, the

connection, the higher the *original incisions* are made, the less is the subsequent cutting necessary.

More recent operations include:

3. Using the Wire Saw Tubular Embryotome. This may be employed in two ways:

(a) By indirect or acute-angled sawing (Fig. 161). The wire loop is passed over the snared limb and up to the axilla, whilst the instrument is introduced up the outer aspect of the leg, until its head lies against the cartilage of the scapula. When using Neubarth's fœtotome, the flat side of the head should be directed towards the uterus and not towards the fœtus. After securing the instrument to the limb by a cord, and whilst

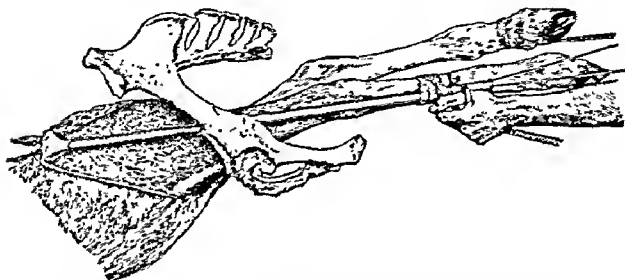


FIG. 161.—AMPUTATION OF THE RIGHT FORE LIMB IN LEFT LATERAL DISPLACEMENT OF THE HEAD, BY ACUTE-ANGLED SAWING, USING THE FŒTOTOME.

In addition to firmly binding the instrument to the carpal or metacarpal regions, its head must be held fast against the side of the thorax in the region of the cartilage of the scapula, by hand (the latter is not shown in the figure).

the operator is constantly applying pressure in order to keep the head in the proper position on the scapula, the work of sawing is commenced.

In this method the direction of sawing is at an angle of 160–170 degrees to the line of traction, and thus the wear on the head of the instrument is very great. The disadvantage of the method is the frequency with which a part of the upper portion of the blade of the scapula is left attached to the foetal thorax after removal of the limb. This sharp-angled fragment of bone must always, if possible, be removed, before applying traction to the fœtus. This is best effected using the wire saw, after first making a skin incision over the cartilage, with a finger knife or Vennerholm's knife.

of the right limb), and the wire saw inserted. The limb is snared, and after passing the wire loop into the axilla, the embryotome is introduced along the dorsal vertebræ, on the opposite side, as far as possible, and



FIG. 164.—AMPUTATION OF THE EXTENDED LEFT FORE LIMB IN A CASE OF LATERAL DISPLACEMENT OF THE HEAD TO THE RIGHT, USING THE WIRE SAW WITH PROTECTIVE SPIRAL TUBES FIXED IN THE HOLDER. The loop of the saw is inserted into an incision which has been previously made along the dorsal border of the scapula.

hooked to the skin. The plate should lie about 10 cm. (4 inches) behind the scapula of the opposite limb, and about two fingers' breadth from the mid-line (see Fig. 163). Fixation by means of the hook is effected by firm pressure of the plate against the skin, and the application of

fœtal head should be amputated previously. The wire loop of the saw is passed over the limb and inserted into the incision, whilst the embryotome is advanced along the mesial aspect of the leg until its head is in the axilla. It is unnecessary to fix the end of the limb to the instrument, but during sawing the head must be held, by hand, firmly in the axilla. Before commencing sawing, it must be ensured that the loop lies between the elbow and the thorax, and not over the lateral aspect of the elbow or shoulder joint.

4. By Means of the Reetz Roller Embryotome (Maximum Angle Sawing). The wire loop is drawn through the roller bearing and provisionally fixed by means of the screw at the posterior end. The embryotome is then introduced along the vertebral column until the rollers

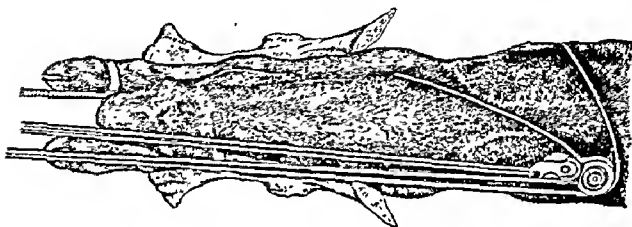


FIG. 163.—AMPUTATION OF THE EXTENDED RIGHT FORE LIMB, USING THE MEYER-SCHLICHTING EMBRYOTOME (METHOD *a*).

lie beyond the cartilage of prolongation of the scapula. It is fixed to the skin, alongside the spinous processes, by means of the hooks. The loop, by tensing the ends of the wires, is advanced into the axilla. During sawing the limb is at first kept tense, to facilitate cutting of the skin. When the saw has cut to about the middle of the scapula region, the limb is pushed forward to ensure that the scapula lies at right angles to the vertebral column and that cutting is between the scapula and the thorax, and not through the bone. (For amputation of the extended fore limb, including the thorax, see p. 305.)

5. With the Meyer-Schlichting Embryotome. Two methods may be adopted:

(a) Using the hook plate (Fig. 163): First of all both spiral tubes are fixed in the plate with their orifices in the same direction (to the right in the case of amputation of the left fore leg and to the left for removal

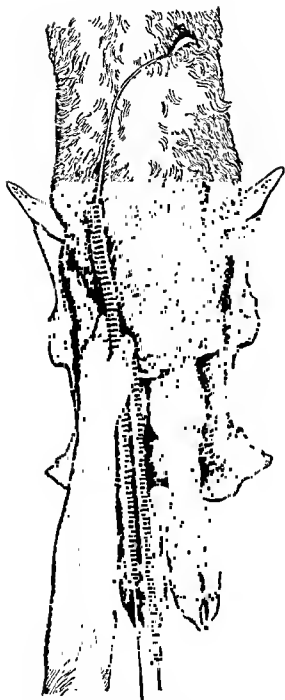


FIG. 165.—AMPUTATION OF THE LEFT FORE LIMB, INCLUDING THE NECK AT ITS BASE, USING A WIRE SAW WITH GLÄTTLI'S SPIRAL TUBES.

This

commencing sawing, a deep incision must be made between the dorsal border of the scapula and the thorax, for insertion of the wire loop.



FIG. 166.—AMPUTATION OF THE LEFT FORE LIMB, TOGETHER WITH THE HEAD AND NECK (NECK-SHOULDER AMPUTATION), USING BÄHLKE'S MODIFIED MEYER-SCHLICHTING EMBRYOTOME.

simultaneous traction on the guiding rod or snare. In this way the wire saw passes around the scapula and over the back. The disadvantage of the method is that if the embryotome has not been fixed far enough beyond the shoulder of the opposite side, the scapula will be sawn through rather than removed completely. In addition, there is a great deal of friction on the wire saw.

(b) Using the holder instead of the hook plate to fix the spiral tubes (Fig. 164): Operative technique is the same as that described in point 3 (b). An incision is made along the cartilage of prolongation of the scapula, through the skin and muscles, into which the wire loop is inserted. The spiral tubes are fixed by means of the holder, which is held by hand in the axilla.

6. Using the Wire Saw with Glättli's Protective Spiral Tubes, but without a Holder. The operation is performed in the same way as in 5 (b), except that the spiral tubes, which are of greater strength, are held with the hand. Their position should be between the humerus and the lateral aspect of the base of the neck, so that the loop of the saw is prevented from deviating laterally. To avoid the spiral tubes becoming excessively hot, it is necessary to have intervals of rest during sawing.

Simultaneous amputation of the neck at its base may be combined with that of the extended fore limb, employing the methods outlined in points 3 (a) and (b), 5 (a) and (b), and 6. The operation, however, makes great demands on the saw, especially when the acute-angled method is adopted, consequent upon the large mass of the foetal body to be divided. The diagonal section extends from the cartilage of the scapula on one side to the shoulder flexure on the other (Fig. 165). The operation is only indicated when the second fore limb lies in the vagina, and thus serves as a point of action for subsequent traction. If the presence of the head in the vagina acts as an obstruction to the effective application of the embryotome, it must first be amputated through the neck. When Meyer-Schlichting's embryotome is used for amputation of a fore limb together with the neck (Fig. 166), the spiral tubes are fixed to the hook plate with their orifices in opposite directions (as in transverse section), the upper being directed towards the shoulder of the limb to be removed, whilst the lower contains the shank of the wire leading from the opposite axilla.

Finally, the engaged or disengaged limb can be amputated percutaneously, after its replacement into the uterus in a state of shoulder flexion posture, by the methods described on page 297.

the fetlock joint, a wooden rod is inserted under the tendo Achillis and fixed by a figure-of-eight cord. By forcible rotation and traction on this, the hip joint is disarticulated and the decorticated limb withdrawn from the pelvis.



FIG. 167.—SUBCUTANEOUS AMPUTATION OF THE NORMALLY PLACED HIND LIMB. Separation of the skin and muscles using Keller's spatula controlled by the hand.

2. Using Pfanz's Extractor (Vienna Model).—This is employed in a similar manner to that described for the fore limb. In order to avoid invagination of the skin while the ring is passing up the subcutaneous tissue, it is advisable to remove the double snare from the fetlock to the pastern joint, once the ring has passed over the

C. PARTIAL AMPUTATION OF THE ENGAGED, OR DISENGAGED, EXTENDED FORE LIMB

If the conditions present make complete amputation of the fore limb impracticable, or if partial amputation of one or both limbs appears to be sufficient to effect delivery of the fetus, section at the elbow or carpal joints, using the tubular embryotome or wire saw with spiral tubes fixed by a holder, may be considered as operations of expediency. To avoid injury occurring during delivery, amputation is performed at the joints and not through the long bones.

An operation which exposes the mother to less risk during delivery, but which is more difficult to perform, is amputation through the shoulder or elbow joint by an open incision, using the finger knife (Vennerholm's knife). This operation would appear to be indicated only when reduction of the size of the thorax is unnecessary, as is the case in foals, or when the presentation is such that removal of the whole limb with the scapula is unfavourable. On principle, methods of embryotomy which produce stumps, especially with sharp, bony edges, are to be avoided, except when they serve as the only points for the application of snares, in which case their entry into, and passage through, the vagina can be supervised.

D. AMPUTATION OF THE EXTENDED HIND LIMB EITHER ENGAGED IN THE PELVIS OR DISENGAGED

As was the case in anterior presentation, when both hind limbs are engaged in the pelvis, amputation of one of them is greatly facilitated by replacement of the other into the uterus.

Subcutaneous Methods

1. By the Keller-Benesch Modification of de Bruin's Method (Figs. 167 and 168). Maximum traction is placed on the limb by means of a foot snare attached to the pastern joint, and a long incision is made on each side of the metatarsus, extending to below the fetlock joint. The skin is then separated, using Keller's semi-sharp spatula, and all muscles within reach, on the caudal and mesial aspects of the thigh, divided. Division of those groups of muscles attaching the anterior aspect of the femur to the trunk is partially effected with the spatula. The mesial incision is then continued up to the pelvis, and separation of the skin and division of the muscles attaching the limb to the pelvis is completed with the finger knife or Vennerholm's knife. After disarticulation

Percutaneous Methods

1. Using the Tubular Embryotome.

(a) *By Indirect or Acute-Angled Sawing* (Fig. 169). The direction of the wire loop, inserted in the groin, forms an angle of 160 to 170 degrees



FIG. 169.—PERCUTANEOUS AMPUTATION OF THE EXTENDED HIND LEG BY THE ACUTE-ANGLED METHOD, USING TRYGESEN'S EMBRYOTOME.

The wire saw has already penetrated the skin and muscles of the buttock. Lateral slipping of the dorsal shank of the saw is prevented by a deep incision extending from the root of the tail to the ischial arch, and thus section through the hip joint is ensured.

with the axis of traction. In this method the instrument is passed along the lateral aspect of the limb until its head is adjacent to the external angle of the ilium. Before sawing is commenced the embryotome must be securely corded to the limb, and during operation its head must be

... The proximal portion of the instrument during extraction of cord. If the thigh muscles are divided with a spatula, finger

3. In emergency cases, in which more elaborate instruments are not available, removal of a hind limb by the subcutaneous method can be performed with the simplest equipment, such as a finger knife or Ven-

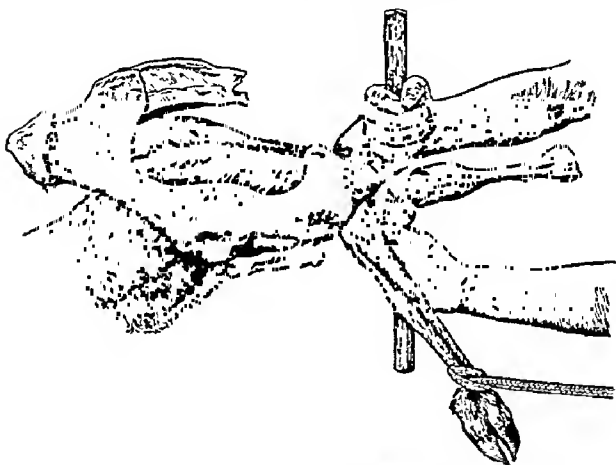


FIG. 168.—SUBCUTANEOUS AMPUTATION OF THE NORMALLY PLACED HIND LIMB. The hip joint is disarticulated by torsion. The other limb is repelled as far as possible. The phalanges in the skin serve for the fixation of a foot snare.

nerholm's knife alone. A skin incision is made on the mesial aspect of the leg, from the fetlock joint to the under aspect of the pelvis, and the fingers are used for separation of the skin. This can be facilitated by producing artificial emphysema by pumping air into the subcutaneous tissue. The muscles connecting the femur to the trunk and pelvis are divided, as far as possible, with the finger knife.

The conditions necessary for success are: The elimination of straining, the absence of impaction of the foetus and a strong arm.

to the opposite side. When using Neubarth's fœtotome, the flat side of the head is directed away from the fœtus.

(b) *By nearly Direct or Obtuse-Angled Sawing* (Figs. 170, 171). The direction of the wire loop makes an angle of 20–30 degrees with the axis of traction. To prevent the saw slipping laterally, a deep incision is made through the skin and muscles from the sacrum to beneath the external angle of the ilium. The loop is introduced up the lateral aspect of the limb whilst the instrument itself is passed up the inside. The head of the instrument (including the fœtal tail) is held by hand in the ischial arch. Fixation of the posterior end of the instrument to the limb is unnecessary. Inclusion of the root of the tail in the wire loop ensures that section is made through the hip joint. Before sawing is commenced, the limb to be removed should be repelled into the uterus, and the stifle and hock joints flexed, because, with the leg extended, there is insufficient support for the wire loop, and it is liable to slip down the femur.

2. *Using a Wire Saw with Glättli's Protective Spiral Tubes* (Fig. 172). The method is the same as that described in point 1 (b), except that the tubular embryotome is replaced by the spiral tubes, which are fixed by hand at the ischial arch. Sawing has to be interrupted frequently, due to the spiral tubes becoming hot. This difficulty is overcome by using the holder to secure them. The conditions necessary for proper amputation are the same as described under point 1 (b).

3. *Using the Roller Embryotome*. The instrument is hooked, as far back as possible, between the vertebral column and the ischial tuberosity, on the side opposite to the limb to be removed. The loop of the wire saw is then passed over the limb until it lies in front of the stifle joint anteriorly and in the ischial arch posteriorly.

4. *Using the Modified Meyer-Schlichting Embryotome* (Fig. 173). When amputating the right leg, the orifices of both spiral tubes are directed to the right, and *vice versa*. The plate of the instrument is fixed about 10 cm. (4 inches) in front of the ischial tuberosity on the side opposite to the limb to be amputated. The flexible guiding rod adapts itself to the pelvic curvature when the instrument is being introduced. The caudal shank of the wire includes the tail and lies in the ischial arch, whilst the cranial shank lies in the groin. During sawing the instrument is fixed by the handle, and the limb is held tense.

In cases of lateral position of the fœtus (Fig. 174) the instrument is fixed about 10 cm. (4 inches) in front of the ischial tuberosity on the same side of the vertebral column as the limb to be removed, but the

pressed firmly against the foetal pelvis. It is important that the dorsal shank of the wire shall lie in the ischial arch. This is facilitated by making a deep incision alongside the root of the tail whilst the tail itself is held

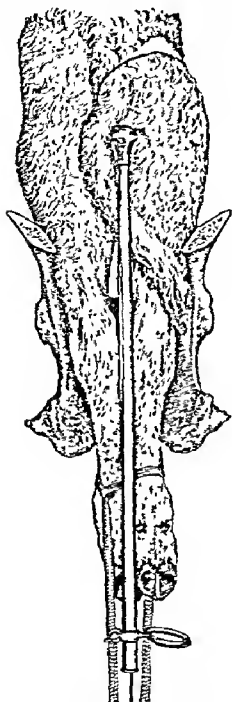


FIG. 170.—AMPUTATION OF THE EXTENDED HIND LIMB BY OBTUSE-ANGLED SAWING, USING THE FÉTOTOME (CORRECT METHOD).

Flexion of the limb, before sawing is commenced, facilitates division through the hip joint.

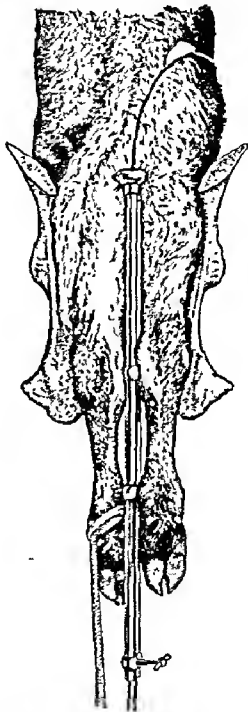


FIG. 171.—AMPUTATION OF THE EXTENDED HIND LIMB BY OBTUSE-ANGLED SAWING (INCORRECT METHOD).

There is a danger of the wire slipping laterally.

tail, and extending to the ischial arch, with a finger knife. Into this the wire is inserted.

Lastly, this embryotome can be used for the amputation of an



FIG. 173.—AMPUTATION OF THE NORMALLY SITUATED HIND LIMB USING THE MODIFIED MEYER-SCHLICHTING EMBRYOTOME.

The spiral tubes are fixed in the same direction.

spiral tubes are fixed with their orifices in opposite directions, as in transverse division, the upper (cranial) spiral being directed towards the limb to be removed and the lower (caudal) to the opposite side. It



FIG. 172.—AMPUTATION OF THE ENGAGED, EXTENDED HIND LIMB, USING THE WIRE SAW WITH GLÄTTLI'S PROTECTIVE SPIRAL TUBES.

For securing the saw in the correct direction, a deep incision is made from in front of the ischial tuberosity to the region of the groin. The spiral tubes are held, with the tail, against the ischial arch. The holder is especially useful in this operation (small figure). Before sawing is commenced the limb to be amputated is repelled into the vagina and the stifle joint flexed.

is important to include the root of the tail in the caudal shank of the wire and to flex the limb as much as possible during amputation. Slipping of the caudal shank from the ischial arch towards the femur, during sawing, can be prevented by making a deep incision near the root of the

CHAPTER 25

METHODS OF AMPUTATION OF THE HEAD AND OF THE LIMBS IN ABNORMAL POSTURES

A. THE HEAD

IN cases of lateral displacement of the head towards the thorax, amputation through the neck can be simply and rapidly performed with Pflanz's embryotome, or with the chain or wire saw, provided the curvature of the neck can be reached by the hand. Before operating, however, it must be carefully considered whether or not by removing the head, and thus losing such an important point of action for axis traction, subsequent delivery of the fœtus will be rendered more difficult than it would have been had amputation of a fore limb instead been adopted.

By Pflanz's Embryotome. Care is necessary, both when introducing and withdrawing the chain knife, to protect the vagina with the hand and arm.

By Chain or Wire Saw. Injury to the maternal passage during sawing can be avoided by using Glättli's spiral tubes. Their anterior ends are controlled by hand.

By the Wire Saw Tubular Embryotome. The head of the instrument is easily fixed by hand, with very little pressure, against the curvature of the neck.

By the Meyer-Schlichting Embryotome. The wire is first passed around the curvature of the neck and the loop completed. The spirals are fixed in the plate with their orifices on the same side, and in the direction of the neck. The plate is hooked to the scapula region of the free limb (Fig. 175). This method aims at complete separation of the neck from the thorax. The operation can also be performed discarding the hook plate, and using the holder only to fix the spiral tubes, in which case the method is one of direct sawing.

B. A FORE LIMB

1. Amputation of a fore limb flexed at the knee is best performed with the wire saw, chain saw or chain knife according to general principles. For passing the chain or wire through the carpal flexure, Lindhorst's

extended hind limb by hooking it to the abdominal wall just in front of the pubic symphysis, with the wire loop directed dorsally.



FIG. 174.—AMPUTATION OF THE NORMALLY SITUATED HIND LIMB WITH THE FETUS IN THE LATERAL POSITION, USING THE MODIFIED MEYER-SCHLICHTING EMBRYOTOME. The spiral tubes are fixed on opposite sides, and the limb is repelled into the vagina.

2. Amputation of One or Both Fore Limbs in a State of Shoulder-Flexion Posture by the Albrecht-Lindhorst, Percutaneous Method (Fig. 176). A wire saw, chain saw or chain knife may be employed, but a preliminary incision is made through the skin and muscles over the dorsal border of the scapula, and into the fissure so created the upper shank of the saw is inserted. Care must be taken to ensure that the ventral shank lies in the axilla. In this way the scapula is removed completely. If the foetal head, lying in the pelvis, obstructs the application of the saw—and this is often the case in absolute oversize of the foetus—it must be removed first. If a rigid tubular instrument is not available,

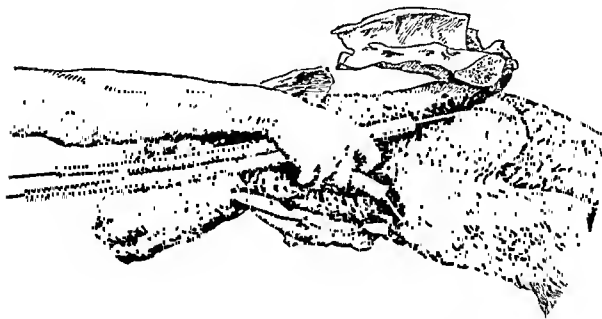


FIG. 176.—AMPUTATION OF A FORE LIMB IN SHOULDER-FLEXION POSTURE, USING THE WIRE SAW ENCLOSED IN GLÄTTLI'S SPIRAL TUBES.

The pocket embryotome with or without holder can also be used. Preliminary incision along the dorsal border of the scapula is essential. Albrecht-Lindhorst employ a chain knife for this amputation.

Glättli's spiral tubes, with or without a holder, may be used for protection of the vagina.

Subcutaneous Method. With the finger knife a skin incision is made over the scapula and up the side of the neck. Using a Keller's spatula controlled by the other hand, the skin is detached from the scapula and humerus regions. With the same instrument the muscles attaching the limb to the thorax are divided to such an extent that a snare can be passed around the neck of the scapula or beneath the head of the humerus. By traction the limb is then drawn through the inverted skin. The operation is made easier by previous amputation of the head, but during dissection with the spatula the neck must be stretched tense.

ring is most useful, whilst when using the wire saw, protecting tubes may or may not be used. As a rule, section should be made as near to the distal carpal joint as possible, so that the proximal part serves for the secure fixation of a traction cord.

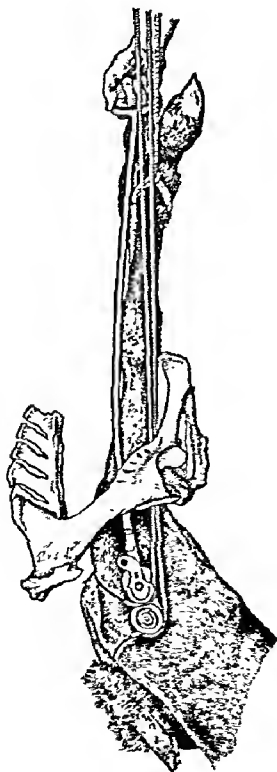


FIG. 175.—AMPUTATION OF THE HEAD AND NECK IN LATERAL DISPLACEMENT IN THE FOAL, USING THE MODIFIED EMERYOTOME OF MEYER-SCHLICHTING.

saw, with protective spiral tubes, or Pflanz's embryotome can be used without difficulty in cases in which the flexed hock is adjacent to or already in the pelvic inlet, and thus within direct reach. But in cases of deep hock presentation and ankylosis, the tubular embryotome or spiral tubes fixed in a holder should be employed. In all cases the angle of sawing can be adapted to the requirements of the individual case.

2. In cases of flexion of the hip joints (breech presentation) division must always be made through the hip joint and not through the neck or shaft of the femur.

(a) *Using the Chain Knife.* Section through the joint itself can only be effected, with certainty, by displacing the fetal pelvis to the side from which the limb is to be removed. This is carried out as follows: Schöttler's double hooks are fixed in the buttocks and by traction the pelvis is drawn to one side (in the case of the right hind limb to be removed to the right, and *vice versa*). The direction of sawing is towards the opposite side. During operation the cords attached to the rings of the chain knife are crossed obliquely to prevent damage to the vagina, or they are enclosed in Glättli's spiral tubes.

(b) *With Pflanz's Embryotome.* The oval ring of the instrument must be fixed effectively against the ischial tuberosity on the side from which the limb is to be removed. If this is not done, the chain knife tends to slip sideways and section is made through the femur.

(c) *With a Wire Saw Tubular Embryotome* (Fig. 179). The head of the instrument is lightly directed against the ischial arch and the tail is included in the wire loop.

(d) *With the Wire Saw held in Glättli's Spiral Tubes.* The ends of the spirals, together with the tail, are held against the ischial arch by the hand.

(e) *With the Wire Saw and Protective Spiral Tubes fixed in the Holder.* The spirals, fixed in the holder, are passed to the root of the tail and held in this position during sawing. The root of the tail is included in the wire loop.

(f) *Using the Hook Plate of the Meyer-Schlichting Embryotome.*
Method I: The spiral tubes are fixed to the plate in the same direction. After passing the wire around the groin with a guide, the free ends are passed through the spiral tubes, using the threading sound. The plate is hooked to the flank or lumbar region of the opposite side.

Method II: Before commencing the instrument is prepared as follows: A spiral is fixed in the anterior circular plate, and through it is passed the wire. Over the free end of the wire the second spiral is passed, and

C. A HIND LIMB

1. Amputation of a hind limb in hock-flexion posture is always performed through the distal row of tarsal bones, for if section is made

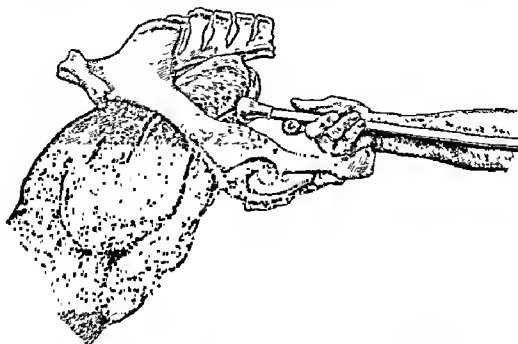


FIG. 177.—AMPUTATION OF THE LEFT HIND LIMB THROUGH THE DISTAL ROW OF TARSAL BONES, IN A CASE OF IMPACTED BILATERAL HOCK FLEXION, USING THE MODIFIED NEUBARTH FOETOTOME.

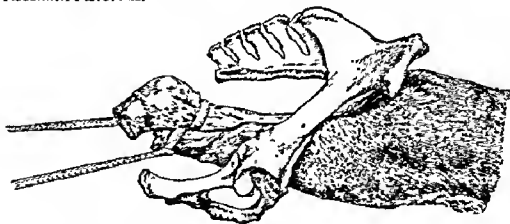


FIG. 178.—ILLUSTRATION OF THE RESULTS OF THE CORRECT (LEFT LIMB) AND INCORRECT (RIGHT LIMB) POSITIONS FOR SAWING, IN CASES OF HOCK-FLEXION POSTURE.

There is no hold for the subsequent application of the traction cord on the stump of the right leg.

above the tuberosity of the os calcis, the point of action for subsequent traction on a snare is lost (Figs. 177, 178). Pfanz's embryotome and the steel wire saw are most suitable for the operation, as the chain knife and chain saw are liable to become fixed in the bones. The ordinary wire

CHAPTER 26

FORMS OF DIRECT OPERATION ON THE FŒTAL TRUNK

SOME method of division of the foetal trunk is generally indicated when delivery cannot be effected owing to excessive size of the foetus, the presence of putrefactive emphysema or to an insufficient width of the genital passage. Division of the trunk into two or more parts is also indicated in certain faulty presentations, correction of which has failed or been impossible from the outset, and in some cases of malformation. When the obstruction to delivery cannot be overcome by removal of the head and/or the limbs, the following methods of operation on the trunk are employed:

1. Destruction of the Vertebral Column, using the Rachiphore (Stüven)

In head presentations, after drawing the head downwards by means of eye hooks, the cranium is opened and the spinascope is passed through the foramen magnum into the vertebral canal. The rod of the rachiphore drill and the handles are then applied, and drilling commenced. Drilling is continued until examination with the spinascope indicates that the sacrum has been reached, and the vertebral column completely broken down. The instruments are then withdrawn simultaneously. Having done this, the foetus can generally be extracted until its pelvis lies against the maternal pelvic inlet. After suitable preparation the foetal pelvis is divided, using the chain or wire saw.

When the cranial region is inaccessible in cases of head presentation, drilling may be performed through the nasal cavity.

In posterior presentation one of the hind limbs is first removed or the size of the pelvis is reduced with the pelviciast. After dividing the lumbosacral articulation, the rachiphore rod is introduced, through the lumen of the sixth lumbar segment, into the vertebral canal. Drilling is then performed as far as the cervical region.

2. Embryotomy, using the Vakufakt (Becker-Schöttler)

(a) *Head Presentation.* As a preliminary operation the foetus is decapitated, using a wire saw. The guiding rod is then introduced up the

then a special Meyer-Schlichting handle (see Fig. 153, *a*) is used to secure both saw and spiral. Having done this, the hook plate is introduced and fixed to the flank or lumbar region of the opposite side. The handle serves now as a guide to pass the spiral tube and the wire around the groin of the fœtus, the tube acting as a protection to the vagina. Having withdrawn the free spiral tube from the vulva, the special handle is removed and the tube again passed forwards to be fixed between the circular and eccentric plates of the instrument.

It will be found, however, that provided precautions are taken, the more simple method (I) can be quite satisfactorily carried out.

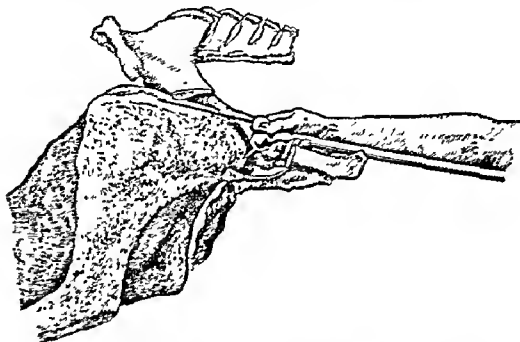


FIG. 179.—AMPUTATION OF THE LEFT HIND LIMB THROUGH THE HIP JOINT, IN BREECH PRESENTATION, USING THE MODIFIED NEUBARTH FETOTOME.

Subcutaneous Methods. For the subcutaneous amputation of a hind limb in a state of hip flexion posture, the following provisions are necessary: (1) Fixation of the buttocks by snaring the tail, using an anal hook, or applying double hooks. (2) A deep incision to extend from the hip joint to the ischial tuberosity. (3) Division of the muscles connecting the femur with the pelvis, using Keller's spatula, the finger knife or by hand. (4) Disarticulation of the hip joint—dividing of the round ligament and tearing through the joint with a snare. Finally, by means of a snare applied to the femur below the great trochanter, the limb is forcibly drawn through the skin. If the muscles have been insufficiently divided there is a likelihood that traction will cause separation of the distal epiphysis of the femur.

Similarly in cases of curvature of the vertebral column its removal can be effected in stages.

(b) *Posterior and Breech Presentations.* The vakufakt is especially suitable for removal of the pelvic floor and hip joints. For this purpose a harpoon-shaped hook, instead of a guiding rod with knife or a spiral saw, is used to support and direct the cylinder. The hook is inserted into the foetal abdomen, either through the anus, or preferably from the ventral aspect between the semi-membranosus and semi-tendinosus muscles after incision of the skin, and then fixed to the brim of the pubis.

As a general rule, after sawing around and removing one hip region, the foetus can be drawn back sufficiently for division of the lumbar vertebral column to be effected with a knife, and thus providing an opening for the insertion of the guiding rod. From this point the use of the vakufakt is as previously described. Removal of the second hip-joint region or of a limb is only necessary in exceptional cases.

(c) *Dorso-transverse Presentations.* In these cases removal of a portion of the vertebral column, with the vakufakt, is a preliminary to final division of the trunk with a chain knife, chain or wire saw. After fixation of the vertebral column by a harpoon hook inserted through a small cutaneous incision and hooked to the vertebræ, one or more portions of the vertebral column are sawn around and removed, so that the rigid body becomes bent at an angle. By this means the introduction of the saw, for the final division of the foetal trunk, is rendered much easier.

3. In Anterior Presentation

Amputation of both fore limbs with the thorax, after previous removal of the head, using the roller embryotome of Reetz (Figs. 180 and 181). After amputation of head (p. 274) the embryotome is introduced along the vertebral column and fixed, by means of its hooks, between the scapulæ. The wire loop is then passed beneath the limbs until it lies around the thorax in the region of the xiphoid cartilage of the sternum. Sawing is commenced at right angles to the line of traction and continued, under control of the hand, until division is effected as far as the under aspect of the vertebral column. The hooks are then sheathed and the roller instrument withdrawn. Glättli's spiral tubes, or some other form of tubular protection, are passed over the shanks of the wire, and held by hand beneath the stump of the neck. Sawing is recommenced, but now its direction is almost at right angles to the first line of division.

vertebral canal as far as the lumbar region, and upon rapid withdrawal its knife becomes hooked into the wall of the canal. After removing the handle of the guiding rod, the extension wire is attached to it. The movable bearings are then inserted into the cylindrical tube and the latter is passed over the guiding rod with its extension. The handle is next attached to the free end of the extension wire. The trephine is advanced to the amputation stump and sawing commenced, by right-handed screwing. During operation the guiding rod is kept tense. Sawing is continued until the red mark on the guiding rod is seen at the posterior end of the cylinder. By this time the trephine has reached the knife of the guiding rod. The extension wire is then removed and the handle attached to the posterior end of the guiding rod. By rotating the latter the tissues are divided at right angles to the axis of the cylinder. Finally, the instrument is withdrawn with the vertebral column of the foetus in the cylinder.

The foetus can now, as a rule, be withdrawn as far as the pelvic girdle. The latter is reduced by the methods outlined on p. 311.

If, consequent upon curvature of the spine, the guiding rod cannot be introduced as far as the lumbar region, the vertebral column must be removed in stages.

When the spiral saw, recently introduced by Becker, is used instead of the guiding rod with the knife, the operation is performed as follows:

The foetal head is amputated and the foetus fixed, either by snaring the fore limbs or applying hooks to the stump of the neck. Secure fixation is necessary to prevent rotation of the foetus during operation. The spiral saw is then rotated up the neural canal for a distance of 70 cm. (28 inches) (this point is marked on the rod). The lumbar region has now been reached. The action of the saw, which, it will be recalled, is able to rock upon the rod through the medium of its joint arrangement, is that vertebral bodies are sawn to a depth of 1.5 cm. ($\frac{3}{4}$ inch) and the bones broken down. Having done this, the handle is removed and the extension wire attached. The cylinder of the vakufakt is then passed over the guiding rod to the stump of the neck. Whilst strong traction is applied to the stump, sawing is commenced by rotating the cylinder to the right, and continued until the mark on the guiding rod is seen at the posterior end of the cylinder. The spiral saw is next fixed by means of the bolt and key, and then by rotating it to the left the vertebral column is completely divided in the lumbar region. The cylinder and spiral saw are removed together. If delivery of the foetus cannot now be effected under reasonable traction, the pelvic girdle must be divided.



FIG. 181.—REMOVAL OF BOTH FORE LIMBS WITH THE THORAX AFTER AMPUTATION OF THE HEAD.
Stage II.—The embryotome is removed, but the wire saw is left in position. Using Glattli's spiral tubes, division is continued beneath the vertebral column. (To make the diagram more clear the viscera have been omitted in this figure.)

4. In Posterior Presentation

Diagonal division of the thorax in cases in which the fore quarters are abnormally large after removal of the hind parts (see Fig. 182). The fetus is eviscerated and the stump fixed by means of double hooks. Using a guide, the wire saw is passed along the back, insinuated between the base of the neck and one of the fore limbs, and finally drawn out again from beneath. The wires are drawn through the tubes of the embryotome (or Glattli's spiral tubes with or without the holder), and

In this way the thorax beneath the vertebral column and the two fore limbs are separated and removed. The intact vertebral column, with its

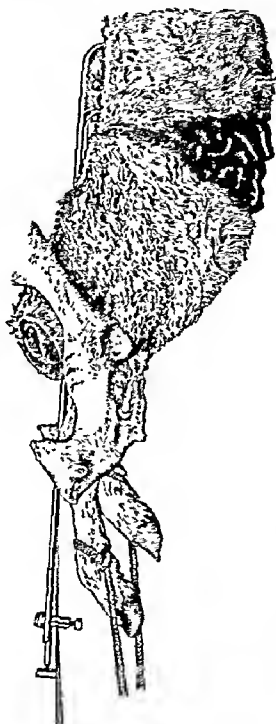


FIG. 180.—REMOVAL OF BOTH FORE LIMBS WITH THE THORAX AFTER AMPUTATION OF THE HEAD, USING THE ROLLER EMBRYOTOME OF REITZ.

Stage 1.—Vertical sawing is carried out until the wire is above the cartilage of the scapula.

skin covering, serves for the application of traction to bring the hind quarters within reach of the hand. After evisceration and removal of the asternal ribs, the hind quarters are divided (p. 311).

5. Transverse Division of the Fœtus in Longitudinal Presentations

Division of the fœtus at right angles to the line of traction can be successfully performed, at any point along the trunk, with one or other

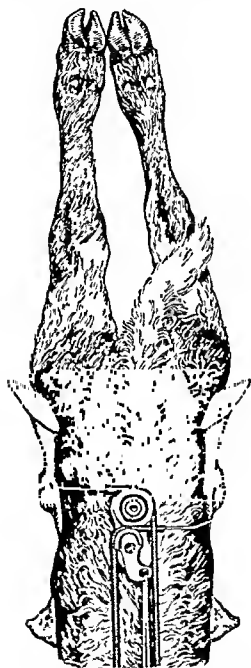


FIG. 183.—TRANSVERSE DIVISION THROUGH THE LUMBAR REGION IN A CASE OF ANTERIOR PRESENTATION ENGAGED AT THE HIPS, USING THE ORIGINAL EMBRYOTOME OF MEYER-SCHLICHTING.

The hook plate is secured by a snare.

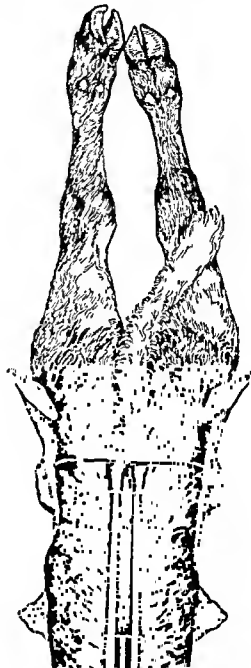


FIG. 184.—TRANSVERSE DIVISION IN THE LUMBAR REGION, USING THE HANNOVER MODIFICATION OF THYGESEN'S EMBRYOTOMIE.

of the wire saw embryotomes. In cases of anterior presentation, after removal or reduction in size of the fore parts it is necessary to make a

the head of the instrument is held on the opposite side of the thorax. The diagonal section thus produced divides the fore part of the body into two unequal parts, one consisting of the head and neck, one fore limb and the smaller portion of the thorax, and the other of the larger part of the thorax with the remaining limb. Division may also be effected

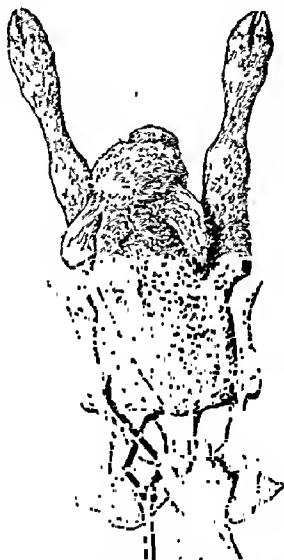


FIG. 182.—DIAGONAL DIVISION OF AN ABNORMALLY LARGE FORE QUARTER, USING A WIRE SAW AND SPIRAL TUBES FIXED IN A HOLDER.

with the head of the embryotome fixed against the stump of the vertebral column, rather than against the thorax on the opposite side, and thus obviate the necessity for completely sawing through the thoracic vertebral column; but for this to be done it is essential that the thoracic stump shall be short.

Finally, it must be stated that complete removal of a fore limb alone is often sufficient to enable delivery of the fore quarter to be effected.

During sawing the instrument is held lightly. When using the Meyer-Schlichting embryotome the spiral tubes are fixed with their orifices in opposite directions, and the plate is hooked to the skin in the lumbar region. The roller embryotome is also hooked in the same position.

6. Longitudinal Division through the Sacrum of an Abnormally Large Hind Quarter

This operation, which is carried out after the trunk has been shortened by transverse amputation through the lumbar region, can be performed with any of the chain or wire saw instruments (Figs. 185 and 186). The wire, with the aid of a guide or introducer, is introduced from above, to one side of the base of the tail, and drawn out below between the legs. Before sawing is commenced it must be ensured that the wire lies in the ischial arch and that it has not slipped to one side towards the stifle region. When using the wire saw, division is usually made in the mid line, although it may be made obliquely. In this case the wire loop, by including the base of the tail, is fixed on one side, whilst the head of the instrument is held in the flank on the opposite side (longitudinal diagonal division, Fig. 187).

7. Subcutaneous Division of the Trunk in the Lumbar Region

This operation is performed as a part of total embryotomy in anterior and ventro-vertical presentations, when a wire saw embryotome is not available. To carry it out it is necessary to deliver the fore part of the body, either by forced traction or after amputation of one fore limb (rarely both) by subcutaneous or percutaneous methods. A long vertical incision is made on each side of the thorax immediately beyond the scapula, leaving a narrow bridge of skin intact at the withers and sternum. Into these Keller's spatula is inserted and the skin separated as far as the lumbar region. The fore quarter outside the vulva is next divided and the fœtal thorax and abdomen eviscerated. Division of the vertebral column, between the last lumbar segment and the sacrum, is effected through the fœtal body cavity, using Vennerholm's knife whilst strong traction is being applied to the stump. Having divided the spine, the muscles are cut through (the skin is already separated) and the trunk removed. The hind quarter is finally delivered in the ventro-vertical (dog-sitting) position, after snaring the hind limbs. The skin flaps serve to cover the amputation stump. If the pelvic girdle is still too large to be delivered by traction, it is necessary to divide it longitudinally, using a chain knife, chain or wire saw.

transverse division in the lumbar region, so that the hind quarters shall become accessible for subsequent longitudinal division (Figs. 183 and 184). The embryotome is introduced along the spine and the loop of

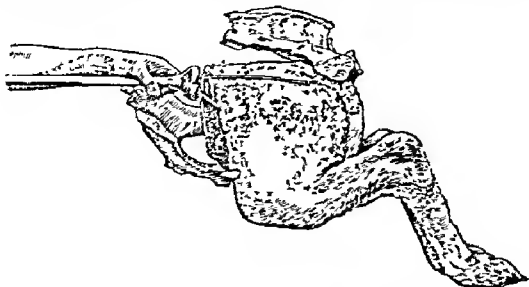


FIG. 185.—LONGITUDINAL DIVISION OF THE PELVIC GIRDLE AFTER TRANSVERSE AMPUTATION IN THE LUMBAR REGION, USING THE FŒTOTOME.

The wire saw is introduced dorso-ventrally in the ischial arch, using a Schrieber's introducer or Lindhorst's ring. This is the last stage of total embryotomy in anterior presentation.

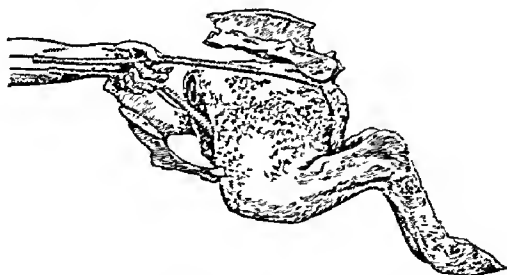


FIG. 186.—DIVISION OF THE PELVIC GIRDLE, USING THE WIRE SAW AND GLÄTTLI'S SPIRAL TUBES

The holder may be used for securing the spiral tubes. This operation can also be performed with the chain saw, Pfanz's embryotome, or the reinforced chain knife.

the saw is passed around the abdomen in the lumbar region. When using the Hannover instrument, the tubes are introduced unconnected, and by passing one of them around the loins the wire snare is completed.

two stages. The vertebral column is first divided by means of the chain knife or wire saw passed through the abdominal cavity after the flanks have been incised with the finger knife and the viscera removed (see also division with the vakufakt, p. 272). After this preliminary operation it is generally possible, by traction with double hooks on one stump, to bring the remainder of the abdominal wall within reach for complete division with the chain knife.

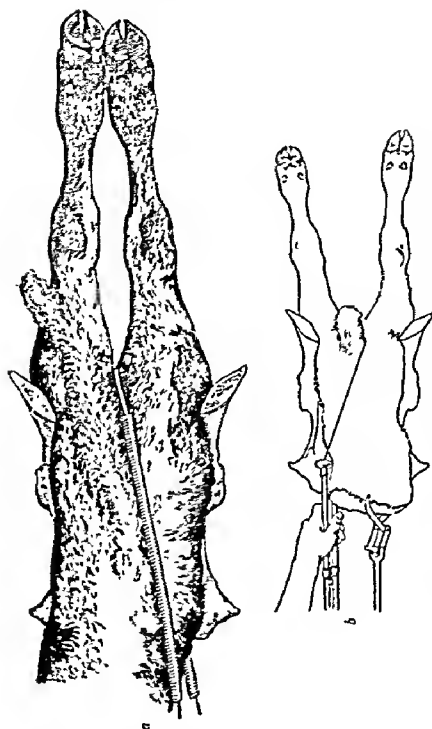


FIG. 187.—DIAGONAL DIVISION OF AN ABNORMALLY LARGE HIND QUARTER, (a) USING THE WIRE SAW WITH GLATTI'S SPIRAL TUBES, (b) WITH THYOESTEIN'S EMBRYOTOME.

8. Division of the Fetal Trunk lying transversely in Front of the Pelvis (Dorso-transverse Presentation)

In those cases in which it is possible to pass a snare around the fetal abdomen, complete division of the trunk may be effected by a single operation, using Pflanz's embryotome, the chain or wire saw. When, however, this is impossible, it is necessary to perform the operation in

side the vulva and then carefully drawn forward by tightening until it lies appropriately at the edge of the fissure; or by the use of vulsellum forceps the cervix may be drawn back to the vulva, the fissure seen, and the sutures inserted in the usual way.

(d) Perforation of the uterus. When this has occurred the prognosis is almost invariably bad. When the flesh value has to be preserved, immediate destruction of the animal is advisable. It is only in rare cases of small perforations of the dorsal wall of a non-infected uterus that an expectant attitude can be adopted.

Jöhnk * reported two cases in the mare in which penetrating wounds of the uterus, caused by delivery of the foetus, healed without treatment.

3. Finally, it must be determined whether any injury to the bony pelvic canal has occurred, especially when the degree of force applied leads to a suspicion that such may be the case. Amongst conditions to be borne in mind are fracture of the floor or lateral walls of the pelvis or of the sacrum, separation of the symphysis or injury of the sacro-iliac articulation. In some cases a diagnosis cannot be made at once, and a positive opinion is not expressed until the following day, when consequent upon displacement of the fragments or continued recumbency of the animal, diagnosis becomes certain. Treatment of the more simple injuries, such as slight degrees of distorsion and luxation, is on expectant and symptomatic lines, but in all cases of severe injury destruction of the animal is the only question to be considered.

* Jöhnk, "Geburtshilfe beim Pferd," Berlin, 1934.

CHAPTER 27

EXAMINATION OF THE MOTHER AFTER DELIVERY

It is the duty of the obstetrician to make a thorough examination of the maternal genital passage immediately after delivery of the fœtus. In addition to injuries caused during extraction, such as laceration of the vulva or rupture of the perineum, which are visible externally and can be treated on general surgical principles immediately, an internal examination is necessary to determine the following:

1. Whether another fœtus is present in the uterus. Experience shows that abnormality in the presentation of a second fœtus often gives rise to complications in parturition such as uterine sepsis consequent upon putrefaction of the fœtus. Twin pregnancy can generally be detected if the arm, as far as the shoulder, is introduced into the uterus.

2. Whether injuries to the concealed soft parts of the genital canal have been caused, especially when excessive force has been employed. Common injuries are:

- (a) Small, superficial fissures in the mucous membrane, especially of the vagina. These only require immediate attention when hæmorrhage is severe. It should be controlled by tamponage, suture or ligature.

- (b) More extensive but non-perforating wounds of the vagina. These usually heal readily provided there is no uterine infection. When the latter is present there is a danger of local necrosis. This may also occur in ruminants when cotyledons have been torn away, and thrombus infection of the afferent vessels may develop. Thus retention of the foetal membranes is a serious complication when there are uterine or vaginal wounds, and the only treatment of this condition which can be applied immediately after delivery in large animals is the administration of ecbolics (pituitary extract 10 c.c. by subcutaneous or epidural injection). During the puerperium ointments and powders may be used.

- (c) Lacerations of the cervix. These generally occur when the cervix is incompletely dilated at the time of delivery, and also after previous vaginal hysterotomy. Prognosis is generally doubtful or unfavourable. At the same time an attempt may be made to suture the fissure provided the uterus is not infected. This may be performed via the vagina, the needle being controlled by the fingers, and the suture first knotted out-

PART III
(J. G. WRIGHT)
CHAPTER 28
CÆSARIAN SECTION

INTRODUCTION

THE name "cæsarion section," indicating delivery of the fœtus at or approaching term by means of laparohysterotomy, is derived from the legend that Julius Cæsar was born in this fashion. The operation has been practised on the dead woman since the earliest times, in fact it was prescribed by Roman Law that every woman dying in advanced pregnancy should be so treated. The operation is of particular interest to veterinarians, for the first recorded instance of its being performed on a living woman occurred about 1500, when a Swiss pig gelder performed it on his wife. It is not unreasonable to assume that his action was prompted by his knowledge of a similar operation in the pig.

The first reference to the operation in English veterinary literature is found in 1839, when John Field of Liverpool briefly refers to the fact that he had twice performed the operation successfully on the bitch. The following year, however, J. B. Carlisle of Wigton, Cumberland, described in some detail the successful performance of the operation on a sow. Neither the uterus nor the abdominal wall was sutured, but the lips of the latter were kept in apposition by "strong adhesive plaisters." Carlisle adds an amazing postscript to his communication, for he says:

"This case does not stand unrivalled, even in my county of Cumberland, for about 16 years ago a farrier named Walker performed the operation on a mare with success. The particulars of the operation I cannot now relate, being at that time quite young, but I recollect that the poor animal was sadly mutilated."

It is a great pity that this latter record is so brief, for if it is true that the mare lived (this the writer strongly doubts) to recover from the operation, then it is a record which, as far as is known, has not been repeated.

The puppies were put on to a foster-mother and did well. The wound had healed in 19 days.

This was a result of which we today might be proud. Sight must not be lost of the fact that there was a complete absence of operative asepsis or antisepsis as we understand them today, for this was twenty years before the Listerian era. The most important lesson to be learnt from this case is that the operation was performed on the evening of the day on which labour commenced.

A striking feature of the parturient animal is the relative ease with which general anæsthesia can be provoked, irrespective of the anæsthetic agent being employed. There is seldom any struggling associated with induction, and anæsthesia is generally induced and maintained with quantities of anæsthetic considerably less than those generally required in the particular species.

THE COW

Although there are numerous records in contemporary literature of the successful performance of the cæsarion operation in the cow, most of these are of single cases and there is little doubt that there has been a still greater number of unrecorded failures. Many veterinarians still doubt the economic value of the operation, and it is of significance that many Continental obstetricians consider protracted embryotomy *per vaginam* to give better results.

The orthodox site of incision for the operation has long been the right flank. By adopting this route, however, there is often considerable exposure of, and manipulation of small intestine. Moreover, a great deal of intra-abdominal traction is required to raise the uterus, which has fallen away from the abdominal wall with the animal in lateral recumbency, into a position for incision.

There is no doubt that these procedures provoke a great deal of shock, and the author's experience of this route of approach has been that while spectacular successes have been obtained, many cases die 24 hours or so after operation. It is probable that this has been the experience of other workers also, for one finds in recent years that considerable attention has been paid to sites of incision other than the right flank. Blending (1939) recorded incision of the ventral aspect of the abdomen, immediately to the right of the midline in front of the udder. Frank and Roberts (1940, 1942) adopt a similar incision—halfway between the midline and the right mammary vein. These authors, in a series of 58 cases, record 78 per cent. of maternal recoveries and a calf survival rate

It is of interest to obtain some evidence of the state of affairs in human surgery at that time, and the following excerpt from the *Lancet* (quoted by the *Veterinarian* (1838), 11, 19) is enlightening:

"Dr. R. remarked that out of the 40 cases where the cæsarian operation had been performed in this country, only three had been successful and one was by an ignorant midwife (author's italics). In France they had been more successful in consequence of the operation being performed earlier, and when the patients were not exhausted but more able to bear the shock."

The passage of a century has done nothing to detract from the force and wisdom of this latter statement, and we of today might well be reminded of it.

So impressed was the editor of the *Veterinarian* (Youatt) by Carlisle's case that he cordially invited his readers to send some details of any other cases of which they might have knowledge, whilst he set out to search French literature. His search revealed that the operation had been successfully performed in that country on the cow and ewe on a number of occasions by Morange, Gohier and Chretien, the last named describing a technique of suturing the uterus and the abdominal wall. Youatt's invitation brought forth a remarkable response from J. Hayes of Rochdale. It appears that he successfully performed the operation by way of an experiment on the bitch, as early as 1824.

By 1840 he had operated on nine occasions, five times successfully: cattle seven, the sow and bitch once each. His method in later cases was suture of the internal incisions and the application of adhesive straps for the integument. It must be remembered that all the cases so far quoted were performed without anæsthesia, for a few more years were to elapse before the anæsthetic properties of ether and chloroform were discovered.

The first detailed account of the operation as a therapeutic measure for the relief of dystocia in the bitch is by Brooks and Whitworth of Grantham (1866). The subject was a fox terrier. During the early days of her pregnancy she sustained what subsequently proved to be a fracture of the pelvis. On the 64th day labour commenced. Operation was performed the same evening.

"The bitch was anæsthetized with chloroform and the hair removed from the site. The abdominal incision was made in the right iliac region, and a longitudinal incision was made in the uterus. Two living puppies were removed. The incision in the uterus was closed with a silver suture wire, leaving the ends thereof long so that they could be removed from the abdominal cavity; then brought the peritoneal surfaces together by suture, also the abdominal muscles and the external skin."

males and often weigh 100 lb. or more (the largest specimen encountered in recent years in the Liverpool School weighed 140 lb.—a bull calf from an aged Friesian cow). Delivery is often effected by uncontrolled forcible traction or after protracted embryotomy. These methods invariably involve the death of the foetus and in not a small proportion of cases that of the mother also. The author believes the caesarian operation to be specially indicated in such cases.

Pregnancy Toxæmia. This condition is not well recognized in the cow, but the author is familiar with cases of acute, fatal ketosis in the heavily gravid cow. As yet he has had the opportunity of operating on one such case only. The animal was almost *in extremis* at the time. Although the cow died 36 hours after operation, post-mortem examination revealing acute fatty infiltration and degeneration of the liver, there was distinct improvement during the first 12 hours, during which time the animal rose to her feet, ate a little food and expelled the foetal membranes.

Straiton (1945) specially recommends the operation in heavily gravid cows which "go down" and are unable to rise. He states that all his cases have been on their feet within 72 hours of operation.

Gross Swelling of the Vagina and Vulva. In protracted cases, particularly in heifers, when there has been extensive manual interference the vagina and vulva may have become so swollen and dry that it is quite impossible to deliver the foetus.

Irreducible Malpresentation. While it is customary to include this heading under the indications for the caesarian operation, provided the foetus is of normal size and is not the victim of some teratological deformity, malpresentations can generally be overcome by vaginal manipulation with or without resort to embryotomy. The introduction of epidural anaesthesia has greatly facilitated such procedures.

Hydramnios. Caesarian section should be considered in those cases in which the life of the mother is threatened due to the gross distension of the uterus and simpler forms of treatment, such as the administration of stilboestrol, have failed.

Mummified Foetus in utero. This is a condition which requires special consideration. Veterinarians have long been acquainted with the presence of a partially resorbed foetus *in utero*. In the majority of instances the monster is ultimately expelled naturally although there is no regularity in the time after foetal death at which expulsion takes place, but it is generally in the region of the normal calving time. Moreover, as foetal death in such cases generally occurs at about the 5th month of gestation, when it is the size of a rabbit, the mother has little or no

of 47 per cent. It is of interest to observe that all but seven of their cases were in first-calf heifers and that forty-eight were of the Hereford breed. The outstanding indication was the breeding of immature and stunted heifers. Götze (1939) adopts a ventral incision also, but on the left rather than the right side—a few inches lateral to the mammary vein. Kiddle and Jones (1947) in this country have recorded a success by this route and the author after trials of other sites has selected it as the best.

The author in a series of 26 cases in dairy cows, using a variety of sites of incision, has had 63 per cent. maternal recovery and in recent ones in which a ventral abdominal incision was adopted, 12 out of 16 mothers have recovered. All the full-term calves which were alive when extracted from the uterus have survived; in one case twins.

Indications

Physical Immaturity of the Mother. In herds in which bull and heifer calves are allowed to run together this becomes a frequent indication for the operation. The animals concerned are generally of the beef breeds and are calving at from 13 to 24 months of age. Reference has already been made to the experience of Frank and Roberts in America, and Sutton (1947) in this country has drawn attention to the condition.

Failure of the Uterine Cervix fully to Dilate. This is a relatively common indication both in the cow and the ewe. Examination of the parturient animal reveals the cervix to admit the insertion into it of two or three fingers only, the absence of the mucus plug of pregnancy, and, as a rule, the presence of the amniotic sac in the vagina or hanging from the vulva. The elapse of a reasonable time, some 3–4 hours, shows the condition to be unchanged. Care must be taken, particularly in heifers, not to confuse the condition under review with the progressive dilatation of the cervix during the first stage of labour: a period which is often accompanied by abdominal discomfort and signs of labour.

Fœtal Monstrosities. The chief offender is *schistosomus reflexus*. In many of these, particularly when presentation is dorsal, it is possible to deliver the monster after appropriate embryotomy. In others, and particularly those in cephalo-caudal presentation, prolonged efforts at extraction *per vaginam* fail.

Gross Oversize of the Fœtus. The affected calf may be otherwise normal or it may be diseased—œdematous or emphysematous. The incidence of grossly oversized healthy calves is relatively common and the author's experience has been that the Friesian, Shorthorn and Red Poll breeds are frequently involved. The calves concerned are generally

Should this occur the cow generally dies in a period of 24 to 48 hours from acute peritonitis. Furthermore the case is not suitable for cæsarian section for reasons previously stated.

The Time of Operation in Relation to the Onset of Parturition

In the dog we have learned that prognosis is closely related to the nearness to the onset of parturition at which operation is performed and that the removal of healthy living fœtuses by hysterotomy is followed by a high maternal recovery rate, whereas the similar removal of dead and putrefying fœtuses generally results in death of the mother from peritonitis. Such is not the case in the cow, for provided the case is not grossly protracted and she is still in reasonably good condition, and in addition that she has not been subjected to injury by prolonged vaginal interference, she is able to tolerate contamination of her peritoneum by the infected contents of the uterus. The author bases this statement on two successful cases which were performed 24 and 36 hours after the onset of the second stage of labour and in which the fœtuses were commencing to undergo putrefactive emphysema. One was a *schistosomus reflexus* and the subject a primiparous Friesian. She showed very little departure from health during the immediate post-operative period and in her subsequent lactation yielded 1030 gallons. She has since calved again normally. A feature of these cases is that the placenta is generally detached and removal of the fœtal membranes at the time of operation presents no difficulties. Curtis (1940) successfully operated on a heifer three days after rupture of the water bag.

The Fœtal Membranes

In most cases in which operation is performed for the relief of dystocia and in which second-stage labour has already been in existence some hours, it is found that the fœtal membranes are already detached or that attachment is so loose that simple traction on them causes easy separation; they should be removed at operation. When, however, operation is performed as a preparturient measure or early after the onset of labour, it is generally found that the cotyledons are firmly adherent. In the author's opinion no attempt should be made at vigorous detachment, for in many cases they are expelled naturally during the 12 hours after operation, while in those in which they are retained, less harm will result than if the uterine wall is subjected to injury by their manual removal. The last statement is based on an experience of two cases in which the animals recovered and conceived again despite the

difficulty in expelling it despite its distorted form. Cases occur in which long periods elapse without the mummy being expelled (the longest in the author's experience is 2 years), and in these the cow has ceased to be of economic value as she is. A further consideration is the size of the foetal mummy; if it is a large one (foetal death at 7 or 8 months) it will cause severe dystocia if attempts at natural expulsion commence. With the introduction of the synthetic oestrogenic substance stilboestrol dipropionate the condition has become in measure simplified for in the majority of cases the administration of this agent (15-30 mgm. by subcutaneous injection) causes expulsion of the mummy in from 2-4 days.

Two indications for caesarian section occur: those cases in which stilboestrol dipropionate even in very large doses fails to cause expulsion and those in which natural expulsion is impossible due to the great size of the mummy. The prognosis is better in the latter than the former, for owing to the relatively large size of the mummy it is possible to bring the uterus close to the abdominal wall for incision (either the low flank or the ventral routes), whereas in the former the uterus and its contents comprise such a small mass that this may be impossible. The author has recently had two successful cases using a ventral incision on the right side. One was of about six months development and the other was approaching term when death occurred and resorption commenced. Jespersen (1940) has successfully removed a resorbed foetus using a high, left-flank incision.

Under this heading should be considered the case of the putrefying mass of foetal remains within the uterus. The condition differs in many respects from the mummified foetus previously discussed in that the uterine cervix is partially open, the uterus itself is a grossly infected focus and the ovaries do not contain a persistent corpus luteum. In many they are functionless. Such cases do not respond to stilboestrol medication. The mass generally comprises loose foetal bones on which the uterus is firmly contracted, the whole being about the size of a rabbit. In many cases the origin of the condition is a resorbed foetus which was not expelled when the corpus luteum regressed and the cervix relaxed. It subsequently underwent putrefactive maceration. A striking feature of the condition is that the cow suffers little or no ill-health as a result. The author must be frank and state that he does not know how to deal with many of these cases. The cervix seldom allows the insertion of more than one or two fingers and fiddling attempts at withdrawal of pieces of bone may result in uterine rupture.

relaxation of the tail and anus and the absence of response to pricking of the skin of the limbs with a needle. Experience has shown that the dose required varies according to the size and condition of the cow from between 30 and 50 g. The chloral hydrate is prepared as a 10 per cent. solution with 1 per cent. of each sodium chloride and sodium citrate added. Injection is made by slow gravitation and the needle used—12 gauge, $2\frac{1}{2}$ inches long. Induction of anæsthesia is quiet. Chloroform with a suitable mask should be at hand in case it is required. Recently the author has used nembutal when it has been necessary to deepen narcosis. 1 g. is given slowly by intravenous injection and increased if required.

Preparation of Site. An area 15 inches square, immediately in front of the udder and extending from the midline to a point lateral to the left mammary vein, is shaved. This area, the udder and the greater part of the ventral aspect of the abdomen are thoroughly washed with soap and hot water and rinsed. The operation site is finally treated with 90 per cent. alcohol. The region of the incision is surrounded by sterilized rubber sheeting held in position by clips.

Instruments. No special instruments are required, although the inclusion of several sterilized lampwick calving snares is an advantage particularly when dealing with monsters. For suturing the uterus, peritoneum and abdominal muscle, No. 4, 20-day chromic catgut is suitable, and for the skin, No. 8 Chinese twist silk. Suture needles employed by the author are—for internal suturing; full curved $2\frac{1}{2}$ inches long; and for the skin: half curved 4 inches long (both types having the regular, triangular cutting edges).

Assistance. Four persons form the ideal surgical team: the operator; the first assistant, who carries out routine swabbing, clipping of sutures, etc., and in particular holds the uterus adjacent to the abdominal wall during its incision, withdrawal of the calf and subsequent suturing; the second assistant, who passes instruments as required and maintains a ready supply of ligature and suture material and also assists in the delivery of the calf and attends to its welfare; and a third assistant at the animal's head who administers any further anæsthetics required. Two additional men to hold the ropes and to maintain the animal in position are a great advantage. Under relatively ideal conditions and in a straightforward case, operation should be performed in about 30 minutes. Under field conditions, however, the operator will have to perform most of the duties assigned to the surgical team single handed. Time will be saved if all instruments are laid out on sterilised rubber

fact that they retained the membranes for 9 days after operation. They showed little departure from health that could be ascribed to the retention.

Technique

Restraint. The cow is cast by Reuff's method and when recumbent all four legs are drawn together and secured by hobbles. After the induction of general anæsthesia, the right hind leg is withdrawn from the hobble and secured separately by a noose placed above the hock or

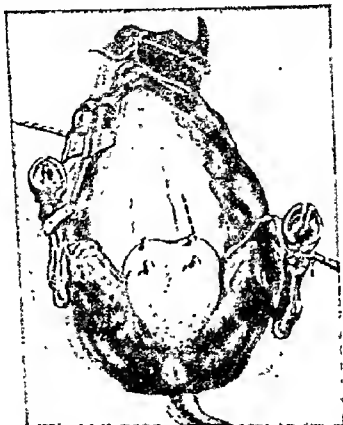


FIG. 188.—CÆSARIAN SECTION IN THE COW.
Method of restraint and site of incision.

fetlock. The animal is then placed on its back and supported in this position by a truss of straw placed against the right chest wall.

(This applies when the left ventral incision is used—the author's practice in cases of full-term fœtuses. When, as in the case of mummies, a right ventral incision is employed, the right hind leg will be freed and drawn back and the cow inclined slightly to the left side.)

Anæsthesia. Anæsthesia is induced by the slow intravenous injection of chloral hydrate into the jugular. Induction should occupy about 5 minutes and in the later stages the depth of narcosis is assessed by

(If, particularly with the right ventral incision, difficulty is experienced with the two layers of omentum, a fairly large aperture should be torn in them and the hand passed through.) The outline of the fœtus within the uterus is readily detected. A second hand is introduced and the ventral portion of the uterus and the parts of the fœtus in it are gently gripped and lifted upwards against the abdominal incision. It is then transferred to the first assistant. Care must be taken when lifting the uterus that the grip is on the fœtus within it and on no account should any attempt be made to hook or lever the uterus upwards for there is a risk that by so doing the broad ligament and its contained blood vessels will be ruptured.

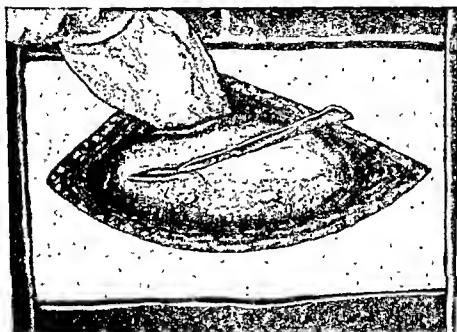


FIG. 191.—INCISION OF THE UTERUS.

In protracted cases in which the fœtus is grossly emphysematous and the uterus itself is also distended by gas, the degree of tension may be such that it is impossible to move the uterus and it becomes necessary to puncture it within the abdominal cavity to allow the escape of gas. Such cases are extremely grave. The size of the distended fœtus may be such that it is impossible to remove it from the uterus without gross laceration of that organ. Moreover, such cases are generally so acutely toxæmic with severe degenerative changes in the parenchymatous organs that death is inevitable.

The operator, having satisfied himself that the organ occupying the lips of the abdominal incision contains a fœtus, incises it about the

sheeting placed on a table or truss of straw conveniently to hand and ligature and suture material prepared and needles threaded before commencing.

Modus Operandi. The abdominal wall is incised parallel with, and some 3 inches lateral to the left mammary vein. For uncomplicated cases the length of the incision will be from 10 to 12 inches, its posterior commissure being immediately in front of the udder. In the case of

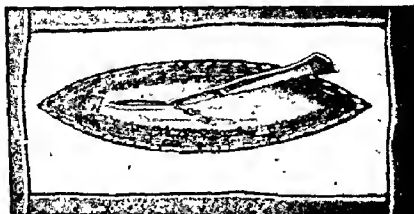


FIG. 189.—INCISION OF THE ABDOMINAL TUNIC.

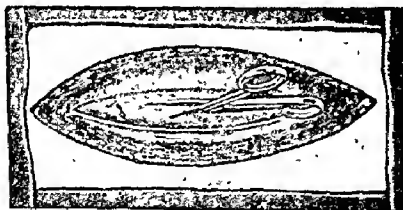


FIG. 190.—CUTTING THE RECTUS ABDOMINIS MUSCLE AND THE UNDERLYING PERITONEUM.

grossly oversized fetuses and monsters, a 15-inch incision should be made. Incision of the abdominal wall requires but little description. It is particularly thin in this region, being chiefly aponeurotic; the muscle fibres involved are those of the rectus abdominis muscle. After carefully puncturing the peritoneum with a knife, incision in it is enlarged using straight Mayo scissors. Immediately beneath the incision lie omentum and the posterior part of the ventral sac of the rumen. These are pushed forwards and the hand inserted well into the abdomen.

kept in mind and traction applied in the upwards and backwards direction. The umbilical cord ruptures as the calf falls over the side of the



FIG. 193.—AFTER WITHDRAWAL OF BOTH FORE LIMBS, THE FETAL HEAD IS INSINUATED INTO AND OUT OF THE WOUND. THIS NECESSITATES PARTIAL ROTATION OF THE NECK. (Subsequent experience has shown that having withdrawn one fore limb it is better to deal next with the head.)

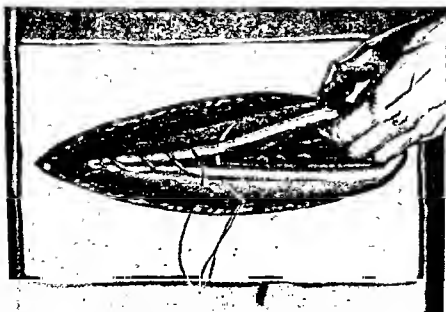


FIG. 194.—CLOSURE OF THE UTERINE WOUND BY A SINGLE LEMBERT SUTURE.

abdomen. Hæmorrhage from it, that is from the portion attached to the calf, may be profuse. In this case a ligature should be applied.

centre of the exposed area using a knife. Portions of the allantois chorion immediately protrude. Incision of the uterine wall forwards and backwards is continued using straight scissors and avoiding cotyledons, to a total length of about 8 inches. This incision is longitudinal in direction and involves the ventral portion of the greater curvature. Cut arteries in the uterine wall should be picked up with hæmostats.

The allanto-chorionic membrane is first cut and then torn with the fingers to allow the amniotic sac to protrude. This is similarly treated. These actions are accompanied by a copious discharge of fœtal fluid, but the greater part of this escapes outside the abdomen as the first

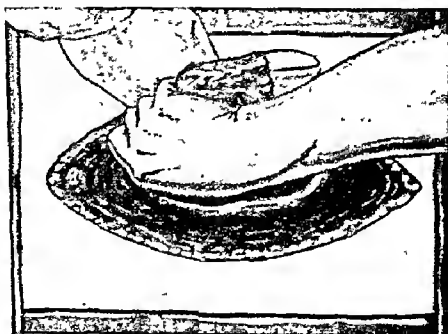


FIG. 192.—THE CASE BEING ONE OF POSTERIOR PRESENTATION, THE HEAD AND FORE LIMBS OCCUPY THE VENTRAL PART OF THE UTERUS. A FORELEG IS WITHDRAWN.

assistant is ensuring that the uterus occupies the lips of the abdominal incision throughout.

The operator next introduces his hand through the aperture in the amniotic sac into the uterus directing it downwards and backwards to grip one of the fœtal hind digits and draw it into and out of the incision, thus extending it. (It is important that the operator shall appreciate the disposition of the fœtus in the uterus: see Fig. 36.) After similarly dealing with the second hind digit the calf is ready for extraction. When the anterior extremity of the fœtus occupies the ventral portion of the uterus (posterior presentation), one of the fore limbs will be dealt with first, then the head and finally the other fore limb. When withdrawing the fœtus the general direction of the uterus should be

The possibility that the case is one of twins must be borne in mind and the uterus and possibly the abdomen further searched. The author has encountered this exigency on one occasion, in which he was fortunate that both foetuses occupied a single cornu and could be extracted through a single uterine incision. In a case of bicornual twinning it will be necessary to deal with the second gravid cornu after suturing and returning the first. In relatively protracted cases in which it is probable that the placenta is already detached, the foetal membranes are withdrawn with or after the foetus. When, however, operation is performed early during the second stage of labour or as a preparturient measure, the placenta will be firmly attached and it is best that no attempts be



FIG. 197.—FRIESIAN COW, 3RD CALVER, 3 DAYS AFTER CÆSARIAN OPERATION
Failure of cervix to dilate; calf in posterior presentation. Mother and calf survived.

made to remove it. Exposed portions of the amniotic sac may be excised.

After ensuring that all exposed portions of the foetal membranes are returned to the uterus, the incision in that organ is closed by a continuous Lembert suture. The suture should commence and end about 1 inch beyond the extremities of the incision; it should underrun the serous and muscular coats about $\frac{3}{8}$ inch with $\frac{1}{2}$ inch of the cut edge turned in.

It is the author's practice to close the abdominal wound by two layers of sutures. The first, which includes the peritoneum, muscle fibres and aponeurosis, is made up of three short continuous sutures. (The continuous suture gives better closure and is more quickly inserted than a series of interrupted sutures, but in order to give it additional

During extraction of the calf, the first assistant has taken care to maintain his grip on the uterus, gently lifting the edges of the incision

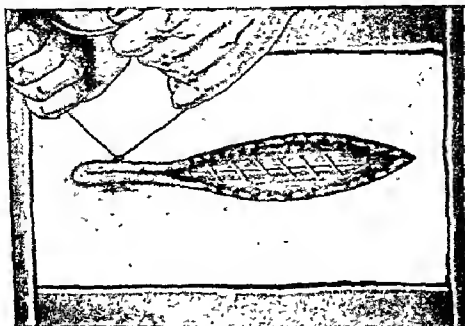


FIG. 195.—AFTER CLOSING THE PERITONEUM WITH THE SUPERIMPOSED RECTUS LAYER, THE REMAINDER OF THE ABDOMINAL WALL IS CLOSED WITH MATTRESS SUTURES.

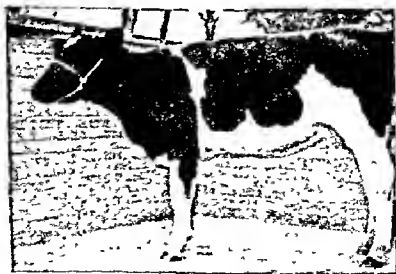


FIG. 196.—FRIESIAN HEIFER 8 DAYS AFTER CESARIAN OPERATION, SHOWING SITE OF INCISION.

Torsion of the uterus with failure of the cervix completely to dilate. Operation delayed; calf dead. Maternal recovery.

in it as he does so. In this way the amount of fluid entering the abdomen is reduced to the minimum and the organ is readily available for suturing.

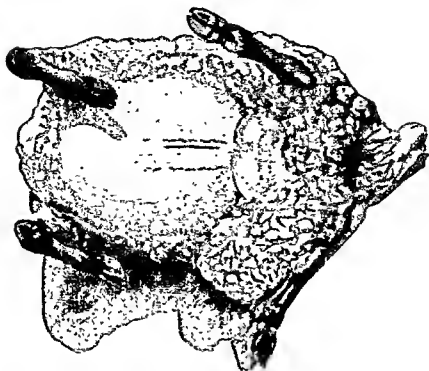


FIG. 198.—CÆSARIAN SECTION IN THE EWE.
Site of ventral incision.

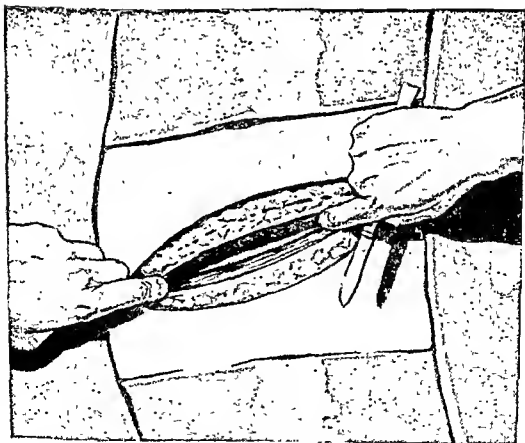


FIG. 199.—CÆSARIAN SECTION IN THE EWE.
Dividing the fibres of the *rectus abdominis* muscle by blunt dissection.

security it is tied off after each 3 inches of suturing.) The skin is closed by a series of mattress interrupted sutures about $1\frac{1}{4}$ inches apart. They are inserted $\frac{1}{2}$ inch from the cut edge.

The skin sutures are removed on the 7th or 8th day after operation. In the majority of cases the wound heals without serious interruption. It should be watched, however, for subcutaneous sepsis arising in the region of the skin sutures, and if such occurs adequate drainage must be afforded. In no case has the author seen post-operative hernia occur.

Provided appetite is maintained, no treatment is given during the post-operative period. If appetite is lost, 120 g. of glucose in a litre of normal saline are given daily by intravenous injection.

THE EWE

Records of the successful performance of caesarian section in the ewe are scanty, but Farquharson (1941) has recorded one such case. The ewe, pregnant with a single, living foetus, was the victim of uterine torsion. Operation was performed under ethloral hydrate narcosis (intravenous infusion to the loss of reflexes) augmented by local infiltration anaesthesia. A right-sided vertical incision was adopted and expulsion of the membranes occurred during the operation.

Other important indications for the operation are: dystocia in ewes with a pelvis so small that the obstetrician cannot pass his hand through it; failure of the cervix completely to dilate and advanced pregnancy toxæmia. The author's experience of the operation is limited to three cases, in each of which the ewe was pregnant with twins, one occupying each cornu. In two the cause of dystocia was failure of the cervix properly to dilate; one being a grossly protracted case and the other a recent one, while the third was a case of acute pregnancy toxæmia in advanced pregnancy. None was successful. In the first two cases, lumbar intrathecal injection was employed with a right flank incision. The first died from shock 12 hours after operation; the second died from peritonitis 5 days after operation, but the lambs were saved. The case of pregnancy toxæmia is worthy of special consideration. The ewe was a Welsh Clun Forest. Deep general anaesthesia was induced by intravenous nembutal (14 grains). A ventral incision, immediately in front of the udder and between the midline and the left mammary vein (6 inches long) was employed. Technique was the same as that described for the cow except that each cornu was incised, the lamb extracted and sutured in turn. The foetal membranes were expelled normally during the night following the afternoon operation. On recovering from the anaesthetic

the ewe immediately commenced to move about and to feed—this was in striking contrast to the persistent recumbency which was present before operation. For 5 days the ewe appeared normal, eating hungrily and suckling her lamb. On the 6th day it was clear that she was ill and she

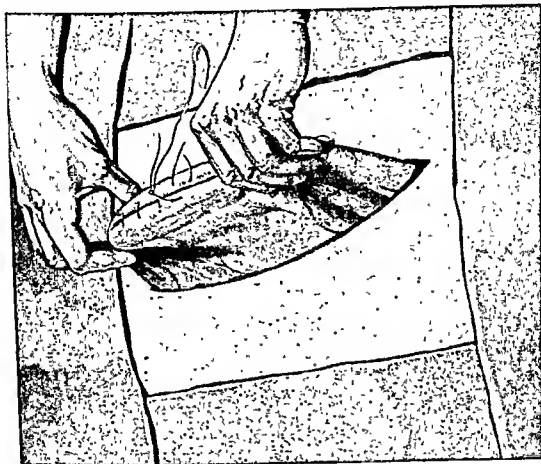


FIG. 202.—CÆSARIAN SECTION IN THE EWE.

An assistant holds the uterus outside the abdominal wound during insertion of a continuous Lembert suture.

died on the 7th. Death was due to peritonitis. In addition there was advanced fatty degeneration of the liver. Despite this loss, the author intends to persevere with caesarian section in the treatment of acute pregnancy toxæmia and commends a trial of the method to others.

THE SOW

The necessity for the performance of caesarian section in the sow arises from time to time, and the operation may be tackled with a fair measure of confidence, for a successful outcome is by no means exceptional. Among the indications are obstructive dystocia in sows whose pelvis is so small that the operator cannot pass his hand through it. Such a pelvis may be normal or it may be deformed as the outcome of previous

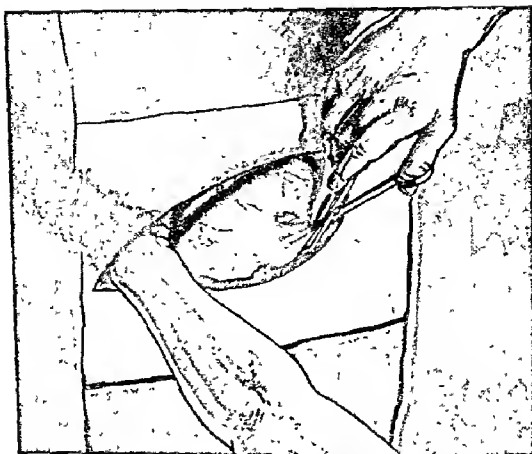


FIG. 200.—CESARIAN SECTION IN THE EWE.
Completion of the uterine incision using straight Mayo scissors.

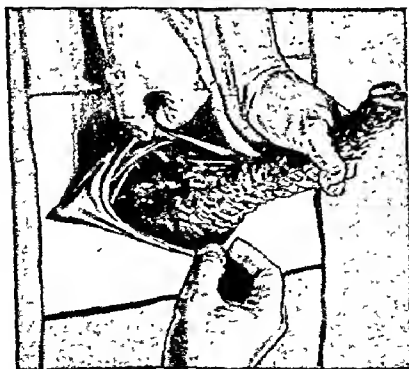


FIG. 201.—CESARIAN SECTION IN THE EWE.
A hind limb is drawn out of the uterus while the lips of the wound in the latter are drawn out of the abdomen by an assistant.

membranes come away readily they are removed, but otherwise they are not interfered with. With extraction of the foetuses, the uterus undergoes vigorous contraction so that the exposed organ becomes less and less voluminous. The cornual incision is closed by a single Lambert continuous catgut suture. The second cornu is then similarly dealt with. In the author's cases, the membranes when left at the time of operation have been expelled normally during the next 12 hours.

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pelvic fracture. A second indication is uterine inertia. It is generally of the secondary type and is associated with a protracted and often assisted labour. One or more fœtuses still occupy the apical portions of the cornua and are beyond the reach of the hand *via* the vagina.

As was found to be the case in the bovine, the sow is able to withstand the passage of an infected fœtus across her peritoneum; the author has had success after the removal of an emphysematous fœtus by cæsarian section 48 hours after the onset of labour.

Anæsthesia. A range of anæsthetic substances gives satisfactory results. Chloroform applied in a mask or on a towel wrapped around the muzzle is simple and comparatively safe. Chloral hydrate by intravenous injection gives good relaxation and is safe provided care is taken to avoid overdosage. A quantity of 6 g. per cwt. bodyweight should be prepared in 10 per cent. solution. Injection is made *slowly* into an ear vein, occupying 5 minutes in the induction of anæsthesia, and stopped when relaxation is complete and there is no response to pricking of the skin. An advantage of the non-volatile narcotics is that the duration of anæsthesia resulting from the initial dose is generally sufficient for completion of the operation and thus no continuous attention to anæsthesia is necessary. A disadvantage of chloral hydrate is the bulk of the solution used having regard to the smallness of the ear veins. If as the result of movement by the animal the ear vein becomes lacerated before injection is completed, the author's practice is to use the Saphena or one of the abdominal veins. The vein is first exposed by incision of the skin over it. The latter procedure greatly facilitates accurate penetration of the vein by the needle.

Nembutal is the most satisfactory anæsthetic. The anæsthetic dose is computed at $\frac{1}{10}$ th grain per lb. bodyweight, but the solution (1 grain in 1 c.c.) is slowly injected until anæsthesia supervenes.

Technique. A longitudinal incision 8 inches long is made in the left flank parallel with but 3 inches above the border of the hypertrophied mammae. A hand is introduced into the abdomen and a fœtus *in utero* located. By gripping the fœtus, the uterus is drawn into the lips of the abdominal wound and the uterus and the allanto-chorionic membrane incised over the fœtal head. After incising the amnion and withdrawing the fœtus, the hand is inserted into the interior of the cornu and second fœtus extracted (the membranes readily break by traction on the fœtus). With the removal of the fœtuses it becomes progressively possible to withdraw the whole of the cornu from the abdomen. Care must be taken that the cornu and uterine body are emptied of fœtuses. If the

parturition is to be normal, is imminent. There are, of course, variations in the length of time occupied in delivery of a litter, and among the factors influencing it, the number of fœtuses involved will be the most important. In the case of an average litter of 4-8 young, the normal duration of second-stage labour is about 6 hours. If, even in the case of exceptionally large litters, it exceeds 12 hours, it may be taken that the case is a pathological one, for it is certain that after this delay the presented fœtus will be dead. It must be borne in mind that during the periods mentioned the bitch must deliver her whole litter, and if several hours of forceful effort have elapsed and the first fœtus is still unborn, it is high time that an examination be made and appropriate assistance given. The same applies when a long interval elapses between the birth of successive fœtuses. In this connection it is difficult to state just how long the bitch should be left unaided between successive births, for in normal parturition there is great variation. The operator will be influenced by the number of fœtuses still unborn and also by the ease and rapidity with which those already born were delivered. As a general rule a period of not more than 4 hours should be allowed to elapse without making an examination. An exception is the case in which the animal is gravid with two fœtuses only and one has been born. As long as 8 hours may be allowed without interference.

The nature of the assistance given will depend on a number of factors: the cause of the primary delay and its duration; the number of fœtuses in the uterus; whether inertia has supervened; the state of the uterine contents and the general condition of the mother. So often, especially in primigravida, the first fœtus is relatively oversized or there is slight deviation from normal such as incomplete rotation into the dorsal position, whereby the animal is just unable to deliver it by her own efforts. Had appropriate assistance been forthcoming using a finger, vectis or forceps, it is probable that parturition would have proceeded normally from this point, whereas, assistance having been delayed, inertia supervenes and despite the removal of the obstructing fœtus no further progress is made. The case may be one in which traction is contraindicated, viz.:

- (a) absolute oversize of the fœtus, a not uncommon condition when there are one or two fœtuses only and in monster formation;
- (b) some gross abnormality of posture which it is impossible to correct, such as lateral or downward deviation of the head;
- (c) abnormalities such as bicornual gestation. In these the mother is exposed to less risk by the early performance of cæsarian section

CHAPTER 29

CÆSARIAN OPERATIONS IN THE BITCH AND CAT

IN the canine and feline obstetrics the cæsar operation now occupies an important place. Reviewing the subject in its broadest aspects the indications are:

(a) for the relief of dystocia;

(b) as a preparturient measure in cases in which it is impossible for normal parturition to occur, or in which it is highly improbable that such will be the case;

(c) the presence of mummifying fœtuses *in utero*.

In the management of a case of dystocia in the bitch the possible performance of the cæsar operation must be considered from the outset. It must not be regarded solely as a last resort, to be performed only when all other methods of relief have proved ineffective, for it is probable that by that time the animal has become exhausted and, what is even more important, the uterus has become a grossly infected focus. The results of the operation are closely related to this point. In a series recorded by the author (Wright, 1939) 82·7 per cent. success to the dam was obtained when the operation was performed as a preparturient measure or up to 24 hours after the onset of second-stage labour, whereas only 30 per cent. maternal recovery occurred when operation was performed between the 28th and 50th hour. In protracted cases such as these, better results follow hysterectomy than hysterotomy. The greatest error which can be made in the management of difficult labour in the bitch and cat is delay, for so often the negative policy of "giving her plenty of time" leads to the loss of both mother and young. It is highly probable that this attitude is the outcome of human experience, for it would appear that in woman the first stage of labour—that of dilation of the cervix—is often a painful and prolonged procedure. In the bitch and cat, however, this stage is characterized by psychological rather than physical disturbances—the seeking and preparing of a place for confinement—and it may be taken as certain that once the objective signs of labour are present (straining has commenced) second-stage labour has been reached and the birth of the young, if

sidered when the uterine contents are relatively sterile and the mucosa healthy, for if putrid fœtuses are removed by hysterotomy, mortality will be very high. In such cases it is inevitable there will be a considerable mortality whichever operation is performed, consequent on the acutely toxæmic state of the bitch at the time, but the results following hysterectomy are significantly better than those following hysterotomy. Contamination of the peritoneum and of the lips of the wound is inevitable in either case, by in hysterotomy the septic uterus is left *in situ* and subsequent necrosis of the edges of the uterine wound is an important lethal factor; whereas in hysterectomy, section is made in the region of the cervix or even through the anterior vagina, the mucous membranes of which are much more resistant. It is impossible to state categorically the earliest time after the onset of labour at which the uterus must be regarded as a grossly infected focus, for the time elapsing before the onset of putrefaction varies in different cases. The author has had cases recover when hysterotomy was performed as late as 48 hours after the onset of the second stage of labour, while in others the bitch was *in extremis* from acute toxæmia after a delay of 24 hours. A number of factors will influence the onset of infection and the rate at which it progresses: the time of fœtal death, the nature of any vaginal interference, the integrity of the fœtal membranes, the number and site of the fœtuses remaining, the degree of impaction at the pelvic brim, etc. As a general rule hysterotomy may be performed with confidence during the first 12 hours. Between 12 and 24 hours hysterotomy is still the operation of choice; the fœtuses occupying the cornua will probably be alive; but the risk is greater. From 24 to 36 hours hysterectomy is recommended. It is probable that many if not all of the fœtuses are dead and that putrefaction is rapidly progressing. Prognosis is guarded. After this time, although occasional recoveries occur, the outlook is grave.

Anæsthesia

Selection of the anæsthetic to be employed requires special consideration, for not only has the welfare of the mother to be borne in mind, but that of the young also. It is the law in Great Britain that abdominal operations in the dog shall be performed under general anæsthesia, so that spinal and regional anæsthesia do not come up for consideration. During recent years nembutal anæsthesia has attained great popularity for major surgery, and those familiar with its use are loath to adopt any other method. Yet it must be stated categorically that for the performance of cæsarian section in the bitch and cat when it is desired to obtain

than by the prolonged use of forceps and often the piecemeal removal of the fœtus.

On reviewing one's experience of dystocia in the bitch one finds that there is a striking breed frequency. The condition is relatively uncommon in the large breeds of dog and in the mongrels. In general, it is more common in the toy breeds, oversize of the fœtus or over-distension of the uterus being the common causes. In the brachycephalic types—the bulldog and the pekingese—oversize of the fœtal head is commonly met. But of the British breeds of dog, the Aberdeen terrier is undoubtedly the worst offender, and inertia appears to be the cause. The author finds that 40 per cent. of the cæsarian operations he has performed for the relief of dystocia have been in this breed. In some cases one or more fœtuses are born naturally after which all evidence of labour ceases despite the fact that there are obviously more fœtuses in the uterus. In others there appears to be a state of partial inertia from the outset, which soon becomes complete.

Animals are met in which parturition, if it is allowed to proceed, must inevitably result in dystocia. Severe pelvic deformity consequent on previous fracture and occlusion of the vagina by neoplasm are examples. When it is known that such abnormality exists, cæsarian section should be performed a few days before or immediately at the onset of labour if it is desired that the puppies be saved. If the life of the puppies is immaterial, it is probable that hysterectomy will be advised as soon as pregnancy is detected.

Acquired inguinal metrocele is common in the bitch and not infrequently embryos develop in the incarcerated cornu. In the majority of cases it becomes necessary, consequent on the severe tension in the sac, to operate for its relief between the 25th and 35th days of gestation, but a case has been encountered (Wright and Hobday, 1932) in which fully developed fœtuses were removed by hysterotomy through the hernial sac.

Choice of Operation

While the term cæsarian section refers, in the strict sense, to the removal of fœtuses by laparo-hysterotomy, a second operation has to be considered in canine and feline surgery: cæsarian hysterectomy—complete extirpation of the uterus and its contents. The first operation must be the primary consideration, for its adoption does not interfere with the subsequent fertility of the bitch. Moreover, it is the interference of lesser magnitude and, other factors being equal, is the one more likely to have a successful outcome. Nevertheless, it should only be con-

Technique—Hysterotomy

A left-flank incision $3\frac{1}{2}$ – $4\frac{1}{2}$ inches long is employed. Its direction is parallel with the spine, commencing 1– $1\frac{1}{2}$ inches behind the costal arch

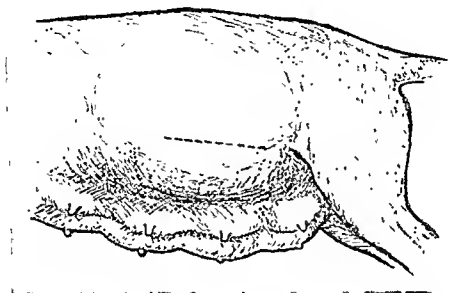


FIG. 203.—CÆSARIAN HYSTEROTOMY IN THE BITCH. SITE OF LEFT FLANK INCISION. (*Veterinary Record*.)

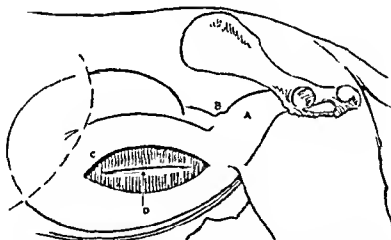


FIG. 204.—CASARIAN HYSTEROTOMY IN THE BITCH.

Diagram to illustrate sites of abdominal and uterine incisions:
A, uterine body. B, division of cornua. C, abdominal incision. D, uterine incision.
(*Veterinary Record*.)

and a similar distance above the border of the hypertrophied mammae. In cases in which there is marked abdominal distension this incision is directly over the cornu on that side. On incising the skin and subcutaneous fat, two or three small vessels will be cut. It is better to ligate

living foetuses nembutal is contra-indicated, for if it is given in doses which provoke general anaesthesia in the mother, foetal mortality will be very high. As a rule if vigorous resuscitative efforts are applied immediately after the placentæ are detached, the foetuses can be stimulated to breathe; they are, however, in a state of deep narcosis with respirations slow and shallow, and although they continue to live for a few hours, the great majority eventually die. In cases in which the foetuses *in utero* are already dead or if it is not desired that they shall be saved, nembutal is the anaesthetic of choice. Before discarding nembutal it was given a trial in sub-anaesthetic doses and full anaesthesia subsequently induced by the inhalation of ether. By this means puppy mortality was reduced, but losses were still high (25-50 per cent.). Being reluctant to discard the barbiturates, the use of the very short-acting pentothal sodium was explored. Injection was made to the point of general muscular relaxation and anaesthesia continued with ether. The bitch recovered very quickly once inhalation was discontinued, but the puppy mortality continued on the whole to be high, although there were marked variations. In some cases the greater part or the whole of the litter could be saved, whereas in others all the puppies died.

It has long been recognized that foetuses are practically uninfluenced by chloroform and ether. By their adoption, however, the induction and continuation of anaesthesia become more cumbersome, while with chloroform in particular the danger to the mother is greatly increased. As a general rule when using inhalation anaesthetics in the dog, morphine pre-narcotization is employed; in fact, without such pre-narcotization induction may be difficult and even dangerous. But in the operation in question even morphine may have a markedly depressing effect on the foetal respiratory centres, but this is much less than with the barbiturates. Thus, for caesarian section in the bitch which is still strong and vigorous and in which it is desired to obtain living foetuses, the author uses a small preliminary dose of morphine sulphate (grain $\frac{1}{40}$ - $\frac{1}{30}$ per lb.) to which with advantage may be added atropine sulphate (grain $\frac{1}{20}$ - $\frac{1}{30}$ total dose) to control salivation, by subcutaneous injection and followed some 15-20 minutes later by inhalation anaesthesia. In the case of small dogs and cats ether is used throughout, while in large dogs anaesthesia is induced with chloroform and continued with ether. In the cat no pre-narcotization is employed. In a recent publication, Freak (1948) strongly recommends the combination of morphine and pentothal sodium for caesarian section in the bitch.

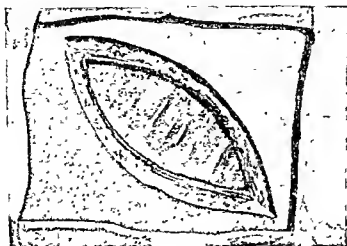


FIG. 206.—INCISION THROUGH SKIN, FAT AND SUBCUTANEOUS CONNECTIVE TISSUE.

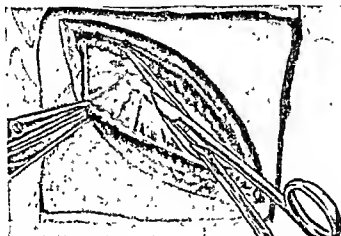


FIG. 207.—INCISION CONTINUED THROUGH THE EXTERNAL OBLIQUE MUSCLE AND THE APONEUROSIS OF THE INTERNAL OBLIQUE.

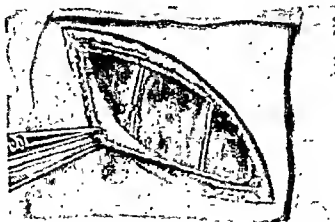


FIG. 208.—BENEATH THE APONEUROSIS OF THE INTERNAL OBLIQUE MUSCLE LIES THE TRANSVERSALIS WHICH CARRIES THE MAIN BLOOD VESSELS AND NERVES.

these than to rely on forcipressure. Beneath the fat the external oblique abdominal muscle will be recognized. It occupies the whole of the incision except the postero-ventral $\frac{1}{2}$ inch or so, where it is aponeurotic. Beneath this muscle the connective tissue may contain a considerable amount of fat. Deep to this lies the fibrous aponeurosis of the internal oblique muscle. This should be incised carefully, for immediately

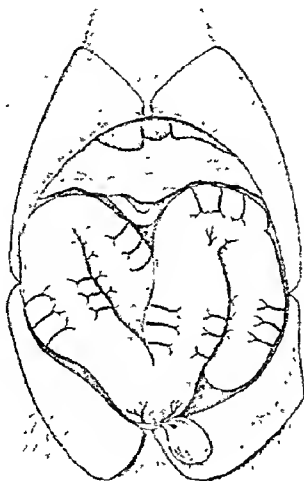


FIG 205.—THE DISPOSITION OF THE UTERUS IN LATE PREGNANCY IN THE CAT.
(*Veterinary Record*.)

beneath it is the transverse abdominal muscle carrying the largest vessels which will be encountered during incision. Having exposed the transverse muscle throughout the whole extent of the incision, its surface is studied. Two or three large lumbar nerves will be seen and in addition several vessels, one in particular about the centre of the exposed area. These should be ligated above and below. The peritoneum, which lies immediately beneath the transverse muscle, is

cornu, it is impossible to withdraw the cornu on account of its size and tension (Figs. 204, 205), and if subjected to rough traction there is a grave risk not only that it may rupture but that the highly vascular broad ligament will become injured, with hæmatoma formation in it or even severe hæmorrhage. When gripping the uterus to fix it in the lips of the abdominal incision in order to incise it over the extremity of a fœtus, the operator must have in mind the disposition of the gravid uterus in the abdomen (Fig. 204). He should introduce his fingers into the anterior commissure of the abdominal wound and draw the cornu gently upwards and backwards. In this way he exposes the cornu about its centre and traction is applied to the point at which the broad ligament is of the greatest length. A longitudinal incision is made into the cornu about 2 inches long and on that aspect of it farthest away from the broad ligament. If possible it should be made over a fœtal extremity; in any case, care should be taken to avoid a placental zone. The adjacent allantois-chorion may be incised with the uterus and as much as possible of the escaping fluid is taken up with swabs. The amnion is similarly treated. Applying traction to its head or buttocks, the fœtus is withdrawn. If the incision is situated over the trunk of the fœtus, a finger is inserted into the uterus and the fœtus pushed in the appropriate direction until an extremity is beneath the wound. After withdrawal of a fœtus the bulk of that segment of uterus becomes so greatly reduced that it is outside the abdominal cavity. The fœtus is still attached to the uterine mucosa by its umbilical cord and the placenta. To facilitate separation of the latter, the outside of the cornu over the zone is gently squeezed with the fingers. This causes the placenta readily to peel away. If attempts are made to detach the placenta by traction on the umbilical cord alone, the uterine mucosa will become everted. Once a fœtus is delivered, the withdrawal from the abdomen of the remainder from that cornu is relatively easy. In any case, the next fœtus is squeezed forwards or backwards until its membranes bulge through the uterine wound. These are ruptured and the fœtus gripped and removed. In this way one cornu and the uterine body are emptied. To make certain on this point, traction should be applied to the anterior part of the cornu until the ovarian bursa is exposed.

The next consideration is—shall the other cornu be incised or shall an attempt be made to remove the fœtuses contained in it through the existing cornual wound? If it is distended to a degree which makes it obvious that it contains two or more fœtuses, it is better first to suture the first incision and then to make a second at the most appropriate point. When, however, there is one fœtus only it is generally a simple matter

cut with it. For making this incision the muscle should be gripped with rat-toothed forceps and lifted well up from the abdominal viscera. A small cut is first made with the knife exposing the interior of the abdomen and incision completed with straight Mayo scissors. If this precaution is not taken there is a risk that the uterus beneath will be incised at the same time. If attention is paid to the blood vessels in the manner described, the incision will be almost bloodless. No

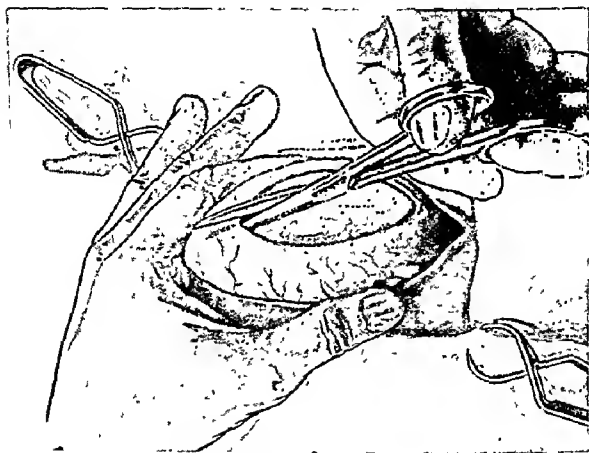


FIG. 209.—CUTTING THE UTERUS OVER A FŒTAL EXTREMITY.

appreciable loss of function appears to follow cutting of the lumbar nerves where they cross the line of the incision.

Uterine Interferences. In the great majority of instances it will be necessary to incise the adjacent cornu within the abdominal cavity rather than first to withdraw it from the abdomen. The surgeon's inclination will be to adopt the latter procedure, for by it the position of the incision in the cornu can be more accurately assessed, the escape of fœtal fluids will be completely outside the abdomen, and in protracted cases contamination of the peritoneum will be greatly reduced. But in cases other than exceptional ones in which one fœtus only occupies the

prior to their incision. The cervix being closed, the uterine contents, despite their unpleasant appearance, are sterile. As much as possible of the dark-green mucoid material which surrounds the fœtuses should be swabbed from the uterus before suturing it.

Closure of the uterine wound requires no detailed description; a continuous Lembert suture is employed and the contracting organ readily adapts itself to inturning of the wound edges.

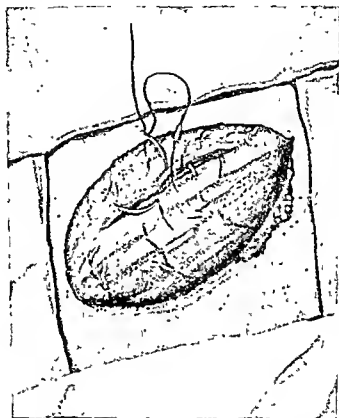


FIG. 211.—CLOSURE OF THE UTERINE INCISION BY A CONTINUOUS LEMBERT SUTURE.

Closure of the Abdominal Wound. The abdominal wall is closed by four layers of sutures. The first includes the peritoneum, transverse muscle and overlying aponeurosis of the internal oblique muscle. The peritoneum of the dog is too delicate to be sutured singly and by inclusion of the aponeurosis not only is any tendency for the sutures to tear through the muscle reduced, but in addition, by drawing together the intermuscular fat, dead space is obliterated. The second layer includes the external oblique muscle. All sutures so far have been of the interrupted type, placed about $\frac{1}{4}$ inch apart. The third layer comprises a few widely placed sutures to draw together the subcutaneous connective tissue and fat. For closure of the skin, mattress type interrupted sutures

to remove it through the original uterine incision. Gentle squeezing of the cornu from the outside and at the same time guidance across the bifurcation with a finger inserted in the uterus generally serve to bring the foetal membranes and the foetal extremity into the wound. Should it be necessary to incise it, the remaining gravid horn is drawn into and out of the abdominal wound. It is probable that owing to the great reduction in intra-abdominal tension and also to the uterine body being empty that this will be simple. Prior to closing the uterus, the second



FIG. 210.—REMOVAL OF A FŒTUS, ITS PLACENTA AND MEMBRANES FROM THE UTERUS.

ovarian bursa should be exposed and the uterine body searched to ensure that all the foetuses and their membranes have been removed.

By this time the cloths about the operation site have become very wet and soiled by blood and placental debris. They should be removed and dry ones substituted.

In cases of intra-uterine mummification operation is less cumbersome. As a rule one or two foetuses only are involved and they occupy the cornua. Foetal membranes and fluids have been resorbed and distension is negligible; thus it is easy to withdraw the cornua from the abdomen

wound with progressive peritonitis and toxæmia. Prolapse of abdominal viscera may occur in this group, which serves to accelerate death.

4. *During the 5-10-day period.* Breakdown of the abdominal wound and prolapse of viscera. In this group infection of the wound is slight or (clinically) absent and the peritoneum is healthy. Interference with the wound by the animal is often the essential factor. The accident may happen quite unexpectedly.

It is not suggested that the four groups are absolutely clear cut; there may be overlapping. The essential feature of 1 and 2 is that the animal was beyond surgical aid at the time of operation. Group 3 is also chiefly concerned with delayed cases. The peritoneum was able temporarily to resist invasion by organisms, but the cut abdominal wall with its open blood-vessels was unable to check infection by bacteria with which it had become contaminated during uterine manipulations and necrosis rather than healing occurred. In this connection it is the writer's belief that contamination is not the entire cause of the necrosis, but that an important contributory factor is the general weakening of the natural bactericidal properties of the tissues by toxæmia at the time of operation. In this group also, prevention by operating before the animal is acutely ill is the only real solution to the problem. The power of healing is not invested in the surgeon: it is a natural process inherent in healthy living cells and success is largely dependent on operating while the cells are still healthy, for if they have lost this power very little can be done to re-establish it. Body heat should be maintained and circulatory collapse combated. The animal should be encouraged to drink—glucose water for preference—in small quantities frequently (large quantities may cause vomiting). Should the animal refuse this, plain water should be offered, or if she will take it—0.25 per cent. saline solution, in small quantities frequently.

The fourth group is the one which requires special consideration. There is a grave risk in the dog after all interferences which necessitate an extensive abdominal incision, and in which the mid-line is used, that breakdown of the wound may occur. Interference by the animal is the chief cause and it is much less likely to occur after a flank incision. The accident generally occurs between the 5th and 10th day after operation, possibly after some of the skin sutures have been removed. The essential cause is irritation of the wound; often some local suture suppuration. The animal commences to lick the wound vigorously, opening the skin and muscle wounds. Beneath these the omentum is encountered, which becomes drawn out on the tongue. The peritoneal irritation resulting

are employed. The author has no special preference for silk, nylon or silkworm gut.

Occasionally post-operative hæmorrhage from the placental zones is severe, and should there be a copious discharge of blood from the vulva after operation, liquid extract of pituitary in doses of 0.5-1.5 c.c. should be given by intramuscular injection.

Care of the Puppies. The puppies are removed from the uterus with the placenta still attached and handed to an assistant whose duty it is to sever the cords by tearing them and dry the skins with cotton-wool. If the puppies do not breathe readily it is the practice to immerse their trunks alternately in hot and cold water. They are then wrapped in cotton wool and placed on a hot-water bottle until the bitch has completely recovered from the anæsthetic, after which they are put with her. Her behaviour with them should be watched, for it has been noticed that primiparous bitches often ignore their puppies after the cæsarian operation, pushing them to one-side rather than mothering them. One speculates whether the intuitive maternal solicitude is dependent on the experience of parturition. Should the bitch ignore the puppies, she should be restrained in the appropriate position while they suckle for the first few days, after which it is highly probable she will take to them. Should hand feeding become necessary, one of the dried-milk foods prepared for babies is used. A little cod-liver oil should be added after the first week.

The Post-Operative Period

In all toxic cases and in early ones in which recovery from the anæsthetic is delayed, glucose-saline solution should be given by intravenous or subcutaneous injection. Body heat should be maintained by the use of blankets and hot-water bottles.

Attention has already been paid to the prognosis of operation and at this point it is proposed to review the causes of post-operative death. These are classified under four, more or less distinct, groups:

1. *Within 24 hours.* A number of factors are concerned, but the chief is the advanced toxæmia which existed at the time of operation. Circulatory disturbances due to the anæsthetic and the operative interference are additional. When chloroform has been used its direct toxic action may be the essential or a contributory cause.

2. *During the 36-72-hour period.* The development of acute peritonitis with death from toxæmia, the uterus being the source of infection.

3. *During the 3-6-day period.* Bacterial necrosis of the abdominal

ing the accident, for the bitch can easily tear away the bandage should she feel so disposed. Muzzling may be adopted, although it is surprising what an animal can do despite the muzzle. Thus when a midline incision is employed, the best procedure is as follows: for the first 4 days the wound is left open and the puppies are put with the bitch. They are then removed and from this time until the 10th day the wound is effectively bandaged. A pad of wool or gauze is placed over the wound, held in position by an encircling open-weave bandage. This is covered by strips of adhesive bandage passing around the abdomen and making direct contact with the skin for a distance of 1 inch in front of and behind the ordinary bandage. The wound is inspected daily. It is seldom necessary to remove all the bandages. Removal of the posterior one or two straps generally allows inspection of the wound. Provided the wound remains dry nothing is done; no irritating antiseptics are employed. Should any suture or subcutaneous suppuration develop, the offending sutures are removed and drainage provided. Sulphanilamide is applied.

Technique—Hysterectomy

In the great majority of cases in which cæsarion hysterectomy is performed the uterus is a grossly infected focus, and thus it is essential that the whole organ shall be removed, at the same time avoiding as far as possible contamination of the peritoneum by its contents. This means that the uterus must be withdrawn from the abdominal cavity unopened. Whether or not this is possible will depend upon the degree of uterine distension and this in turn will be largely influenced by the number of fœtuses. (For this operation a plentiful supply of instruments, swabs, gloves, cloths and clips should be provided, so that contaminated material can be frequently replaced by clean.) The case being a protracted one, the uterus is even less likely to withstand severe traction than was the case in hysterotomy, and consequent upon possible emphysema of the fœtuses and necrosis of the uterine wall there is a great danger of rupture occurring. Should gentle efforts at withdrawal fail it becomes necessary to incise the uterus and withdraw one or more of the fœtuses. In this event the lips of the abdominal wound should be well packed with gauze and frequent swabbing performed. Another important point to be considered is the site at which the uterus shall be excised. Section is best made at the junction of the uterine body and the anterior vagina, i.e. at the dilated cervix. It is essential that this site shall be empty, yet it is probable that it is occupied by a putrid fœtus. This may be overcome in one of three ways.

therefrom provokes vomiting and this in turn by greatly increasing abdominal pressure causes a great part of the jejunum to prolapse



FIG. 212.—CESARIAN SECTION IN THE CAT. VERTICAL FLANK INCISION.
(*Veterinary Record*)

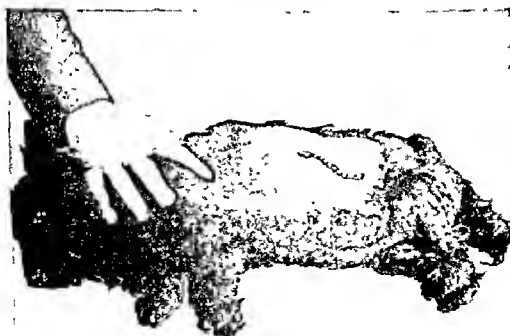


FIG. 213.—CESARIAN SECTION; HORIZONTAL FLANK INCISION.
(*Veterinary Record*)

through the wound. Unless the accident is observed early and immediately dealt with, it is probable that death from shock will occur in a few hours.

Bandaging, in the accepted sense of the practice, is useless in prevent-

sufficient tension can be applied effectively to occlude the vessels. The bursa is then opened between the ligatures, exposing the ovary with its corpora lutea. The stalk is divided with the knife, beneath the ovary. Having released the mesovarium the cornu can be lifted out of the wound, exposing the broad and round ligaments. These structures are comparatively avascular other than near their attached borders, and a single gut ligature is applied before dividing them with scissors.

One cornu now being free, the other is drawn out of the abdomen and dealt with in the same way. In fat subjects difficulty will be experienced in placing ligatures beneath the ovaries, for owing to the com-

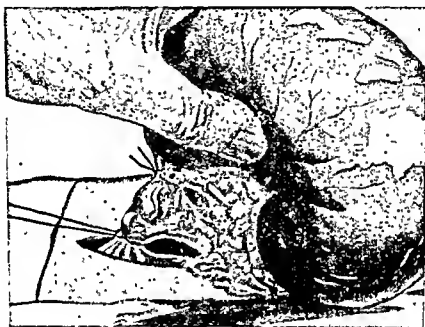


FIG. 214.—CÆSARIAN HYSTERECTOMY IN THE BITCH.
Ligature of the ovaro-uterine vessels.

parative shortness of the mesovarium it will only be possible to bring an ovary into the lips of, instead of out of, the abdominal wound. Whilst it is generally possible, with the help of an assistant pressing down on the lips of the wound and at the same time applying gentle traction to the extremity of the cornu, to apply the ligature below the ovary, the necessity for leaving sufficient tissue above the ligature to ensure that it does not slip may involve leaving part or the whole of the ovary behind. No harm will follow this procedure and it is better to leave the ovary than provoke severe and possibly fatal hæmorrhage due to excessive traction on the mesovarium causing it to tear. Such bitches, if they recover, will probably have irregular periods of œstrus.

(1) Delivery of this fœtus *per vaginam* with forceps prior to operation. Whether this is possible will depend upon the cause of the dystocia.

(2) An attempt, after the abdomen has been opened, to squeeze this fœtus back into a cornu. This will depend chiefly upon the amount of space available in the uterus, i.e. whether or not any fœtuses have already been born.

(3) Incision of the uterus distant from the line of section and the removal of the fœtus occupying the body.

Needless to say, (1) and (2) will commend themselves to the operator and every endeavour will be made to adopt one of them. Unfortunately it often becomes necessary to resort to (3).

Abdominal Incision. When performing hysterectomy a mid-line incision, varying from $2\frac{1}{2}$ to 4 inches in length, is employed. A flank incision is generally unsuitable for the reason that when proceeding to remove the uterus and both ovaries, great difficulty is experienced in ligaturing the deep ovary due to the shortness of the ovarian ligaments.

Control of Hæmorrhage. The blood supply to the uterus is provided by two main arteries on each side. The first, the utero-ovarian, arises from the posterior aorta and passes in a flexuous manner in the mesovarium. After giving off branches to the ovary and the oviduct the main vessel passes backwards in the broad ligament, sending off large branches to the placental zones in the anterior part of the cornu. The second, the uterine, originates in the pelvis as a branch of the internal pudic artery and passes forward in the broad ligament to anastomose with the utero-ovarian. At the anterior extremity of the cornu and posteriorly at the uterine body, the vessels lie close to the attached border. Over the middle region of the cornu, however, they lie in the broad ligament about $\frac{3}{4}$ inch away from the uterus. It is important to bear this in mind, for careless manipulation of the broad ligament may result in laceration of the veins, before the arteries (anterior and posterior) have been ligated, and severe hæmorrhage result. Having withdrawn one of the cornua and the ovary in its bursa on that side from the abdomen, the mesovarium is penetrated by a needle carrying ligature material, beneath and behind the ovarian bursa, taking care that the point of penetration is posterior to the utero-ovarian vein, and the ligature tied off. A second ligature is similarly placed above the bursa to prevent hæmorrhage from the anastomosing branch after division (Fig. 214). Owing to the quantity of fat in the mesovarium it is necessary that these ligatures shall be of stout material so that

is passed through the edge of the uterine wall avoiding the mucous membrane (Fig. 216). The site for the ligature is $\frac{1}{4}$ inch in front of the posterior clamp. The uterus is then divided with scissors immediately behind the

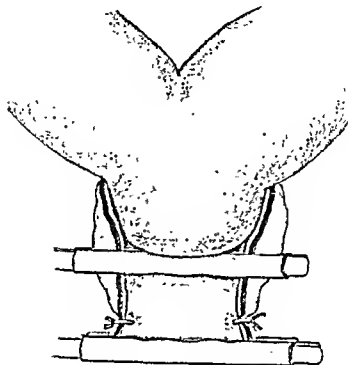


FIG. 216.—LIGATION OF THE INDIVIDUAL BLOOD VESSELS IN THE STUMP.
(*Veterinary Record.*)

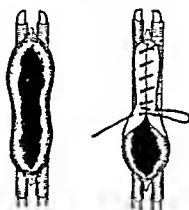


FIG. 217.—CÆSARIAN HYSTERECTOMY.
Closure of the stump.
(*Veterinary Record.*)

anterior clamp. The object of this is that there shall be an adequate amount of stump anterior to the remaining clamp to allow of invagination of the mucous membrane by Lembert sutures (Fig. 217). Before

Both uterine cornua now lie outside the abdominal cavity. Care must be taken that they do not fall to one or other side of the animal, for in so doing rupture of the attached portions of the broad ligaments may occur with severe hæmorrhage. The abdominal wound is packed off as effectively as possible with sterile gauze. The uterus is to be removed by section through the uterine body in the region of the dilated cervix. It is essential that the latter shall be empty. The methods of effecting this have already been referred to. It suffices to state here that should it be occupied by a fœtus an attempt must be made gently to squeeze it back into the cornu from whence it came. If this is impossible it will be neces-

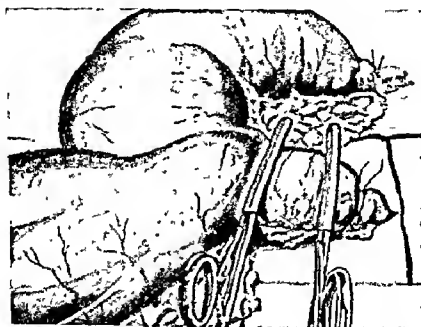


FIG. 215.—CONTROL OF HÆMORRHAGE FROM THE UTERINE VESSELS BY A SINGLE LIGATURE AROUND THE STUMP.

sary to incise the uterus and remove it. This will cause gross contamination, and every effort must be made to reduce it to a minimum by packing beneath the uterus cloths which can be subsequently removed.

Bowel forceps, the jaws of which are covered by rubber tubing, are placed across the uterine body as far back as possible and lightly clamped. A second pair is similarly placed about $\frac{3}{4}$ inch anterior to the first, that is, just posterior to the bifurcation. Between these clamps lies the line of section, but prior to making section it is necessary to deal with the uterine vessels. These are situated on each side in the uterine ligaments close against the attached border. To ensure that the artery as well as the vein is included in the ligature, the needle carrying the catgut

CHAPTER 30

RETENTION OF THE FETAL MEMBRANES IN THE BOVINE

It is generally accepted that within the realm of physiological normality the foetal membranes are expelled within a period of 12 hours after the delivery of the foetus, and that retention of the allantois-chorion within the uterus for longer periods must be considered to be pathological. A striking feature of such retention in the bovine is that it is generally prolonged, often for from 4–8 days or even longer, by which time the membranes have undergone extensive putrefactive changes.

Etiology

Physiological expulsion of the allantois-chorion in those species having cotyledonary placentation is made up of two essential processes:

(a) A loosening of the chorionic villi within the maternal cotyledonary crypts, whereby they detach themselves readily.

(b) Continued waves of peristaltic contraction in the muscle fibres of the uterine wall, whereby the loosening allantois-chorion becomes invaginated and expelled.

Retention results primarily from failure of the villi to detach themselves from the crypts. Early observers (Harms and others) held the view that the most important factor in its causation was imperfect contraction of the uterus in the third stage of labour and belated involution.

Recognition of the part played by *Br. abortus* (Bang) as a cause of abortion in cattle and the changes this infection provoked both in the maternal and foetal placentæ resulted in a general acceptance of the view that the commonest cause of retention of the foetal membranes was a proliferative placentitis resulting from this infection. Götze (1941–42) has recently expressed the opinion that this infection causes about 30 per cent. of all cases of retention in cattle in Germany. While it is generally accepted that the incidence of the condition is higher in those herds in which *Br. abortus* infection prevails than in those which are free from it, many observers have pointed out that retention of the membranes in cases of abortion at 30–40 weeks of gestation only seldom occurs. Moreover, there is a definite incidence of the condition in herds

allowing the stump to recede into the abdomen it is important to ensure that hæmostasis is effective. The sutured border of the stump is lightly gripped with spring forceps and the clamp removed. The stump is held

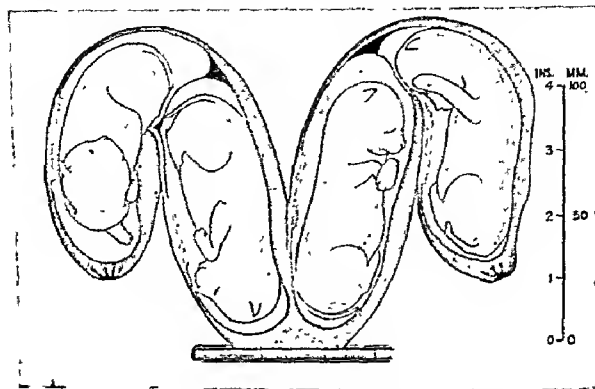


FIG. 218.—THE DISPOSITION OF THE FETUSES IN UTERO IN LATE PREGNANCY IN THE CAT.
(*Veterinary Record.*)

in view for a minute, and should there be any seeping of blood from it, a gut ligature is placed around the whole stump and tied just sufficiently tightly to check it. Closure of the abdominal incision requires no special description.

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chiefly endometrial infection. Cows bred at 30-60 days post-partum largely retain their afterbirths. When gestation periods of the cows bred to a given bull fall outside the optimum duration of 279-288 days inclusive, whether above or below, retained afterbirth will be highly destructive. Retained afterbirth tends constantly to be followed by chronic endometritis or other types of disease interfering with reproduction. If it is decided to attempt to rebreed the cow after retained placenta, it should be borne in mind that the greatest remedy known for diseases of the reproductive system is sexual rest; such rest should be at least 6 months.

The author, in so far as his experience of reproductive disorders of cattle in England is concerned, finds himself unable to accept many of Williams' conclusions. He believes that with the exception of certain specific infections, the chief of which are tuberculosis and *Br. abortus*, the uterus of the cow which carries a normally developed, living calf to full term is a singularly healthy organ and that other causes should be sought to explain retention of the allantois-chorion. There is no doubt that histological changes are generally found in placentæ expelled normally, particularly from multigravid cows, but one should hesitate to conclude that they are necessarily the outcome of bacterial infection of the uterus during pregnancy. English experience does not confirm the view that the calves in cases of retention are generally diseased at birth, nor does it support the statement that the majority of cases are associated with abnormal gestational periods.

Nevertheless, there is a volume of reliable clinical experience which indicates that the condition occurs more often in births which occur a few days before the expected date. The inference to be drawn from this is that the placenta had not yet undergone those degenerative processes which make for normal detachment.

Erismann (1937) in Switzerland, in a study of 270 cases of retention, found 55 per cent. occurring in normal gestational periods (280-294 days). A striking feature of his series was that 50 per cent. occurred in twin pregnancies. Gehring (1937) in Germany examined the placenta expelled normally from 40 clinically healthy cows. The animals concerned ranged from 2 to 21 years old, the average being 8 years; 3 were heifers. He found extensive changes in the majority: lack of cotyledons, changed form of single cotyledons, accessory placental tissue, necrosis and œdema of the villi. In an attempt to define the structure of the normal cotyledon and attached placenta, Kennedy (1947) in Scotland records the histological appearance of 26 specimens obtained at an average time

which are free from that infection. There are many references in the literature to its relatively high frequency in cases of twinning.

It is proposed to pay somewhat lengthy attention to the views of that distinguished pioneer in this field of animal disease, the late W. L. Williams of Cornell University, for there is no doubt that his writings have profoundly influenced veterinary thought in this matter and that his conclusions are widely accepted.

Williams and his co-workers discredit the important place that has been ascribed to *Br. abortus* in the causation of retention, but believe it to be due to an endometritis resulting from some other, unspecified infection which is present during pregnancy, often from its very early stages. They consider ill-health of the newly born calf to be a frequent accompaniment of the condition. Their examination of placenta from cattle in herds in which breeding irregularities were high, revealed almost regularly necrosis of the chorionic villi, and on the histological appearances of the changes formed the conclusion that bacterial infection was the cause. In the healthiest animals this necrosis was restricted to a single cotyledon and was only found after careful examination. Œdema of the chorion was also common and was thought to be the outcome of the placental changes. Absence of placentation, particularly in the non-gravid cornu, and the development of accessory placental tissue, conditions only rarely found in heifers but common in multigravid cows, were regarded as further evidence of the infection hypothesis. The causes of abortion and retention were therefore to be found, in the opinion of Williams and his colleagues, in pathological processes which occurred in the uterus both in the immediate gestational period and in previous ones. The Williams school holds that most of the breeding irregularities, whether they be manifested in the form of abortion, retention of the foetal membranes, post-parturient prolapse of the uterus, or failure to conceive, are fundamentally the outcome of uterine infection. Thus we find them concluding that retained placenta in dairy cattle is largely preventable by the application of conservative methods of breeding, feeding and handling; that the condition is incurable, for when it becomes identifiable at the termination of pregnancy, placental lesions have already become established in the uterine caruncles which remain throughout the life of the female to interfere with reproduction according to their extent and character; and that no treatment can operate retroactively to restore destroyed placental function. Twin pregnancy, so ruinously followed by retained afterbirth, can be largely excluded by avoiding the errors which lead up to twin ovulation and pregnancy,

spherical ones and that detachment of the placenta by hand was very much easier during these waves of contraction than when the uterine musculature was quiescent. He has described the process as being like the action of a fan—as the base of the cotyledon contracted, the periphery opened.

Pugh (1944) expressed the view that an important factor in the post-parturient contraction of the uterus was the stimulus of frequent suckling by the calf. In India, Vinattieri, Hayward and Artioli (1945) have shown that the incidence of retention in buffaloes is strikingly higher in animals from which the calves are removed at birth than in those which are allowed to suckle their young. 189 calvings in which suckling was not allowed were followed by 22·7 per cent. of retention, whereas in 122 cases on the same farms which were allowed to suckle, only 4·9 per cent. occurred. From the foregoing discussion the reader will appreciate that the exact causes of retention in the bovine are still obscure.

Incidence. The author knows of records giving the overall incidence of the condition in the various countries over a long period. Those available have been compiled by individual observers dealing with a relatively small number of herds in a single locality over short periods. Kennedy (1947) in Scotland observed 13 herds for a period of 1 year or less. In 431 calvings there were 36 (8·3 per cent.) cases of retention. Of the latter, 5 were abortions. Palmer (1932) in America reported on 2 herds comprising 125 cows (each was free from tuberculosis and *Br. abortus* infection) over a period of 3 years. The annual incidence was 11·7 per cent. Götze (1941–42) gives it as his clinical experience in Hanover that among every 100 births there are at least 4 or 5 cases of retention.

Pathogenicity. Discussion on the degree of ill-health and the mortality which attend retention of the foetal membranes in cattle is difficult because of the many factors which may be concerned. In the first place it is necessary to differentiate those cases which follow a normal, or at most only slightly assisted, delivery from those which complicate a protracted labour in which vigorous and often prolonged intra-uterine manipulation has been carried out. Again, it is the orthodox practice to treat the condition by manual interference, the severity of which will vary from case to case and from operator to operator, and thus the possibility cannot be excluded that ill-effects which have been ascribed to retention *per se* may have arisen from or have been aggravated by injury resulting from such interference. A further factor to be borne in mind is variation in the duration of retention, although this is not so

of 4½ hours after normal calving. All specimens showed degeneration and necrosis of the foetal elements. Of 31 maternal cotyledons examined the following features are described: epithelium distinctly visible in many cases, but in others absent; necrosis and degeneration of epithelium; crypts filled with debris both foetal and maternal. For comparison the same worker examined the foetal placenta in 14 cases of retention and the maternal cotyledons in 24 retention cases. In only one of the former was there any variation from the findings of normal cases, while none of the cotyledons showed changes in structure from the normal cotyledon previously described.

While a great deal has been written on the association of *Br. abortus* infection and of other non-specified infections of the uterus during pregnancy with retention of the foetal membranes, very little attention has been paid to the possible relationship of some cases to uterine tuberculosis. There is no doubt that the incidence of endometrial tuberculosis during the later stages of pregnancy, and generally of the miliary type, is relatively high in infected herds. The author's experience has been that such infection is not accompanied by retention of the membranes in any significant degree.

Pommayer (1919) concluded from histological examinations that retention of the membranes may occur as the result of congestion of the villi, which causes them to become locked in the crypts. That observer, and many others, have expressed the view that the most frequent cause of retention is uterine inertia due to factors such as debility, protracted labour, uterine infection or premature labour.

Of recent years there has been a tendency to discredit inertia of the uterine muscle during the third stage of labour as an important factor in the causation of the condition. Stress has been laid on the fact that the uterine caruncles do not contain muscle fibres and are thus, in themselves, incapable of undergoing contraction. The author, however, is of the opinion that the inertia factor cannot be so readily dismissed, for it would seem reasonable to assume that the process of detachment is intimately associated with a modified state of the circulation in the caruncular crypts and this in turn is profoundly influenced by the force of uterine contractions. Jordan (1948), working in the author's department, has observed in the full-term uterus of the ewe on the post-mortem-room table and after removal of the lamb, that waves of contraction commencing at the apex of the gravid cornu and sweeping backwards to the base occurred every 2-3 minutes, and that during these contractions the cotyledons changed in shape from oval structures to

TABLE 11

Comparison of Subsequent Breeding Records of Retention Cases with Animals in the Same Herds which Calved Normally during the same Period

Group	Number	Calved at Full-term	Aborted	Times served	Became Sterile	Aborted	Days between calves *
Retention.	44	36	8	Mean 2.5	3	6	429.5
Controls	44	44	—	„ 2.5	2	4	419.5

* The abnormally long period between calvings in both groups is accounted for by the fact that on these farms it is the practice to withhold service for 3-5 months after calving for milk record purposes.

The author's clinical experience of untreated cases agrees closely with Palmer's records.

Götze (1941-42), quoting the records of the Hanover clinic for treated cases—the material forming the basis of these records consisted only for the smaller part of cases which were brought for treatment during the first few days of the disease—gives the following prognosis: death and casualty slaughter, 4 per cent.; emaciation, unprofitableness or infertility, 20 per cent.; short duration of disease and temporary irregularities of milk production and fertility, 50-60 per cent.; puerperium almost undisturbed, 15-25 per cent.

The outcome of the disease both when untreated and when treated after putrefactive changes have become established in the uterus, is that about 75 per cent. of cases show no severe departure from health, but there is a temporary reduction in appetite and milk yield in from 50-60 per cent. Reliable mortality figures, particularly in untreated cases, are not available, but the author is of the opinion that a figure of 1-2 per cent. should be accepted. The adoption of manipulative treatment obscures the picture, for the possibility that vigorous interference with the cotyledons causes injury which increases the risk to the animal cannot be disregarded. In fact, few veterinarians are not familiar with the cow whose well-being was distinctly reduced after manual removal of the membranes.

Jordan (1948) has found that the bacteriological picture of the uterus in retention cases is the same as in those of delayed involution without retention. Group II streptococci (*Str. dysgalactiae*) appear first, followed by staphylococci (often coagulase negative), and later diphtheroid organisms, *C. pyogenes* predominating. Coliform and anaerobic bacteria

important as would at first appear for the great majority of cases persist for 3 days or longer, by which time advanced putrefactive changes have developed in the uterus.

Palmer (1932) carried out careful observations on the pathogenicity of retention. Unfortunately, as he himself readily acknowledges, the numbers dealt with were too small to draw hard-and-fast conclusions therefrom. Nevertheless, the author believes his observations to be so valuable as to merit quotation in some detail.

They were carried out over a period of 3 years in 2 herds free from tuberculosis and *Br. abortus* infection, 44 cases of retention occurred and it was planned to give no treatment unless the life of the animal appeared to be in danger.

RETENTION OF THE PLACENTA IN CATTLE (PALMER, C. C.)

TABLE 8A
Animals Retaining Placenta

Number	Calved at full-term	Aborted	Had twins	Duration of retention (days)	
				Shortest	Longest
				Mean	
44	36 (81.8%)	8 (18.2%)	7 (16%)	2	11
				6.79	

TABLE 9
Condition of Retention Cases during Two Weeks after Calving

Appetite			Bodyweight		Lactation			Treated for illness
Good	Fair	Poor	Normal	Loss	Good	Fair	Poor	
14 (31.8%)	24 (54.5%)	6 (13.6%)	39 (88.6%)	5 (11.3%)	13 (29.5%)	28 (63.6%)	3 (6.8%)	4 (9.0%)

TABLE 10
Cases of Retention—Subsequent Breeding Records

Number	Number of Services	Treated for Infertility	Became Sterile	Aborted	Days between Calvings
44	Mean 2.5	4	3	6	429.5

sequent on the greater degree of uterine contraction present at this time, the operator is more likely to be able to reach the apical portion of the cornu. But it must be acknowledged that even at this time it may be impossible to reach the full extent of the apical portion and it is there that attachment is generally most firm. It must be recognized also that not infrequently cows become much more ill after such interference than they were previously and occasionally manual interference has been quickly followed by death. Williams (1943) in America states that his practice is to make a careful manual examination within one day after parturition and to remove the membranes if it is found that the chorionic placenta can be completely detached without injury to the caruncles. If it is found impracticable to remove them on the first occasion, the examination may be repeated at intervals of not less than one day until the membranes drop away or are removed. Götze (1941-42) in Germany acknowledges that if detachment necessitates force and unclean conditions, to await the spontaneous expulsion of the retained placenta may have real advantages, but claims that by the application of epidural anaesthesia it is possible to carry out manual detachment gently and hygienically and these factors, together with the improved methods of combating bacterial infection now available, lead him to conclude that gentle detachment is justified at all times. He considers that early detachment has the great advantage that it is performed at a time when puerperal infection and intoxication has not markedly developed and there is still a chance to produce an approximately physiological puerperium. Erismann (1937) in Switzerland, after a wide experience of the condition, considers careful manual detachment to be the best form of treatment, but finds himself unable to draw from his records any cogent conclusions as to the most favourable time for interference. He also acknowledges that in a considerable proportion of cases he was unable to effect complete removal. He found the factor which was most often associated with illness was a more or less great accumulation of fluid in the uterus. It is of interest to note that in his series the percentage of animals requiring supplementary treatment (approx. 22 per cent.) was much the same when manual interference was made within 12 hours of birth, between 12 and 24 hours, or after 24 hours.

Despite this weight of opinion in favour of manual detachment, there appears to be an increasing volume of opinion, both in this country and on the Continent, and to which the author subscribes, that on no account should any attempt be made to detach the placental villi from the maternal crypts with the fingers. This view is based on the belief

are also found. In all cases the blood white-cell picture shows the characteristic "shift to the left" of pyogenic infection after the third day.

The influence of retention on the subsequent fertility of the animal is a matter for careful consideration. It has long been held that the condition is a frequent cause of chronic endometritis with a resulting high incidence of sterility, and having regard to the mass of infected material which occupies the uterus, often for many days, in retention cases, this would seem a reasonable conclusion. But on examining one's clinical experience one cannot fail to be impressed by the relatively low number of retention cases which fail to breed again and also by the low number in which the accident is repeated. Conversely one is also struck by the high number of infertile animals encountered in which the last parturition and puerperium were normal. Palmer's observations (*vide ut supra*) in this connection are enlightening. It must be accepted that in all cases of retention, and for that matter in cases of delayed involution without retention, that the uterus becomes and remains an infected focus for a month or even longer and hence there is a theoretical loss of breeding time. But in the majority of cases natural resolution occurs and the animal's breeding potentialities become normal some 2-3 months later.

Treatment

Manual Removal. The proper management of cases of retention of the foetal membranes in cattle has long been the subject of discussion and disagreement among veterinarians the world over. Such discussion has revolved chiefly around the advisability or otherwise of manually detaching the foetal cotyledons from the maternal caruncles. The inclination to carry out such manual interference is a very proper one, for clearly the presence of a mass of putrefying membranes within the uterus can serve no good purpose, while, in addition, the animal owner may well expect that the veterinarian will take steps to remove them. The general experience among English veterinary surgeons in the past has been that attempts at removal during the first 48 hours are usually unsuccessful, for the placenta is often firmly adherent and vigorous attempts at detachment may be accompanied by hæmorrhage and, in some instances, by accidental removal of caruncles. Moreover, the apical parts of the gravid cornu are usually at this time beyond the reach of the hand. For these reasons it has become the teaching and the practice to delay interference until the 3rd or 4th day, by which time considerable putrefactive liquefaction has occurred and separation of the placental villi from the maternal crypts is easier. In addition, con-

Other Forms of Treatment. The "cleansing drench" is a time-honoured feature of the British dairy farm. It generally contains a saline purgative to which has been added ergot of rye. It is unlikely that its administration significantly alters the course of the disease.

If, as is probable, inertia of the uterine musculature is an important factor in the causation of the condition, posterior pituitary extract would appear to be indicated. Benesch (1930) studied the action of this hormone on the bovine uterus and found that its stimulating action was greatest at the time of parturition and that it progressively fell during the next 24 hours. He advises, in cases of anticipated retention, the administration of 10 c.c. immediately following delivery of the calf. Shaw (1938) gave pituitary within 1½ hours of calving, and of 100 cows so treated one only had retention, as compared with a similar herd which was untreated in which 10 per cent. of retention occurred.

The general clinical impression is that once retention has been in existence 24 hours or longer, its course is uninfluenced by pituitary extract. Nevertheless, in herds in which the incidence is high and also in animals in which labour has been protracted and in which retention is anticipated, the use of the agent immediately after delivery of the calf may be of advantage.

Since the synthesis of di-ethyl stilbœstrol by Dodds and his co-workers, this œstrogenic substance has been used in a wide variety of bovine reproductive disorders, including retention of the fœtal membranes. It would appear that its administration increases the sensitivity of the uterine musculature to the whipping action of the oxytocic factor of post-pituitary hormone.

Anderson and Bugg (1942) reported two cases of assisted delivery in which 20 mg. stilbœstrol dipropionate was given by intramuscular injection without effect and the membranes were removed manually 3 days later. They noted, however, strong contractions at the apex of the cornu and commented on the possibility of prolapse occurring.

Frank and Smith (1943) observed two cases. In the first 25 mg. was administered about 6 hours after calving and the membranes fell away 52 hours later. In the second, an 8 months abortion case, the same dose was given about 6 hours after calving; the membranes were expelled 53 hours later.

Vinattieri, Hayward and Artioli (1945) gave two buffaloes with retention of the membranes 25 mg., 3 days and 1 day respectively after calving. The first commenced straining 24 hours later, and almost immediately everted the uterus. The second everted the uterus 7 hours after injection.

that however carefully the operation is performed, damage to the endometrium is almost inevitable and the risks of severe toxæmia and even septicæmia developing are increased. So often manual detachment is followed by severe and prolonged straining, fever, a marked fall in appetite and in milk secretion.

It is not suggested that a manual examination should not be made, but interference should be confined to drawing those parts of the allantois-chorion already detached through the cervix into the vagina and, if they permit it, out of the vulva. In this way the quantity of putrid material in the uterus is reduced and drainage of the accumulated fluids is facilitated. Moreover, the presence of parts of the membranes in the vagina facilitates the further withdrawal of detached portions, and possibly the whole, at the next attempt, by which time the cervix may have contracted to a degree which prevents the insertion of the hand into the uterus. Occasionally cases are encountered in which on first examination it is found that complete detachment has occurred but that the mass has become imprisoned in the uterus by the contracting cervix. These are easily withdrawn.

In those cases in which there is marked departure from health and in which it is found that the uterus is flaccid and contains large quantities of fluid, the removal of the latter by syphonage is indicated. The author's procedure is as follows:

The band, carrying rubber tubing (an equine stomach tube is ideal for the purpose), is inserted well forwards and downwards into the uterus. Two to three pints of hot (about 120 deg. F.) normal saline solution are introduced through the tube (to which a funnel is attached) into the uterus by gravity and just before the funnel finally empties, the free end of the tube is lowered almost to the ground to commence the action of the syphon. The hand in the uterus holds the end of the tube throughout; first to ensure that it lies in the accumulated fluid; second to prevent its causing possible damage to the endometrium; and third, to prevent the membranes being drawn into its lumen during syphonage. The last point is most important for the degree of suction is so great that without this precaution the membranes will assuredly block the tube and as the latter empties itself the syphon will cease to act. By pressing gently downwards with the knuckles a pool of fluid in the uterus can be maintained. Having removed the accumulated fluid, a further quart or so of hot saline is introduced and this is finally removed by the syphon. This treatment should be repeated for several days if the condition of the animal demands it.

It is unlikely that they significantly alter the course of the condition. More recently hygroscopical agents, such as glycerine, hypertonic saline solutions and even crystalline sodium chloride itself, have come into favour.

The findings previously described regarding the bacteriological picture indicate that there is a place both for penicillin and for the sulphonamides in those cases of retention of the membranes in which systemic ill-health supervenes.

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Moore (1946) reported on the use of stilboestrol in 43 cases of retention. It was first given at periods ranging from 24-96 hours after calving in doses of 30-90 mg. In most the dose was repeated a second or a third time. His conclusion was that the drug was of little if any value as an aid to expulsion of the retained membranes. He concluded also that in the dosage used the agent might definitely be harmful in that four of his cases developed a neerotic or catarrhal vaginitis. It must be noted, however, that the dosage he employed was considerably greater than the accepted one.

Chesney (1947) is an advocate of the agent. He reported its routine use in cases of retention, in doses of 10-20 mg. according to the size of the cow, in about 200 cases. He first injected the drug if the animal had not expelled the membranes within 36 hours of calving. In about 60 per cent. of cases they were expelled in from 12-36 hours and no pyometra followed. He found also that if the agent was first administered later than 96 hours after calving, the placenta might be expelled in a day or two, or it might be retained indefinitely. To these a second injection was given 3 days after the first. Only 10 per cent. of his cases did not respond to treatment and he had no reason to suspect the drug of causing permanent or fatal trouble. Adamson (1947) reported similar results.

It is difficult to assess the significance of the favourable reports, for the action claimed for the agent is generally delayed 24 hours or more and there are no comparable controls. It must not be forgotten that even without treatment the duration of retention is very variable.

Several workers (Moore, 1946; Hancock, 1948) have recorded valuable therapeutic effects in pyogenic metritis following manual removal of the membranes and in cases of incomplete involution generally. Doses advised are up to 25 mg. of stilboestrol dipropionate by intramuscular injection, repeated if necessary up to four times.

Despite these favourable reports the author would utter a note of warning against any indiscriminate use of the agent, for he has himself seen a case in which permanent dysfunction of the ovaries followed the administration of 25 mg. at parturition.

A great variety of antiseptics has in the past been introduced into the uterus in retention cases to check bacterial multiplication, and each has had its advocates. They have included boric acid, phenyl-salicylic acid, cresol, flavine and other acridine dyes, iodoform, bismuth subnitrate and silver preparations. Adsorbents such as powdered charcoal have also been extensively employed, particularly on the Continent.

Although the number of mares observed is quite inadequate to draw conclusions, it is of interest to note that there appears to be no correlation between the duration of gestation or the duration of the second stage of labour and the period lapsing between birth and dropping of the membranes. It would seem certain that in the mare, with her simple diffuse form of placentation, that continuation of uterine contractions into the third stage of labour is the essential mechanism both for the separation of the villi from the crypts and for the expulsion of the detached membranes from the uterus. It is of interest to note in the mare also that the allantois-chorion is almost invariably inverted during the process of expulsion.

It is probable that delay in expulsion is caused by a temporary failure of the uterus to contract in sufficient force after the expulsion of the fœtus. This may be due to inertia consequent on lack of tone or it may result from a measure of exhaustion.

Forceful uterine contractions in the mare are generally accompanied by signs of abdominal pain and during the normal process of expulsion of the membranes the animal often becomes recumbent and shows "colic." The author has observed that mares retaining their membranes show no signs of "after pains" during such retention. They appear to be perfectly comfortable and content, taking food and suckling their foals. Body temperatures have ranged between 100–101° F. and pulse rates between 54 and 64 per minute (in the latter connection, it is to be noted that the normal pulse rate of the mare at the time of parturition is in the region of 60 beats per minute—Wright, 1943). The onset of the delayed expulsion of the membranes is indicated by the commencement of colicky pains and they fall away in a matter of 10–15 minutes.

The author believes it important that these facts should be stressed, for it has been the accepted veterinary teaching that retention of the placenta is a serious complication of parturition because of the rapidity with which metritis and toxæmia develop. Fleming-Craig (1930) state that so liable is the mare to septic infection that manual extraction of the membranes is always indicated when they are not expelled immediately after birth. The late Professor J. McQueen taught that if they have not fallen away after 12 hours of the birth of the foal, manual removal should be proceeded with.

Treatment

It is advised that no interference *per vaginam* be made up to 24 hours after the birth of the foal provided the mare's temperature is normal,

CHAPTER 31

RETENTION OF THE FOETAL MEMBRANES IN THE MARE AND OTHER SPECIES

THE MARE

It has already been noted when discussing physiological parturition that the foetal membranes are generally expelled by the mare in a period of from $\frac{1}{2}$ to 3 hours after the birth of the foal. But in this species also difficulty is experienced in defining what period shall elapse before retention can properly be defined as pathological, for not infrequently mares are encountered in which the membranes are retained for periods up to at least 16 hours, yet the animal shows no departure from health ascribable thereto (Wright, 1943).

Table 12 shows the time elapsing between the birth of the foal and the expulsion of the membranes in a group of mares in which parturition was witnessed by the author. In all cases birth was normal and the mares appeared to be in normal health throughout. All the foals were living and of normal development at birth, and all except one progressed normally. The exception died 58½ hours after birth from *Bact. nephritidis equi* infection.

TABLE 12

Parturition in the Mare

Time elapsing between birth of foal and expulsion of the membranes

Mare	Parity	Gestation, days	Sex of Foal	Duration 2nd Stage, minutes	Delay in Expulsion of Membranes, hours
Rosie ..	<i>Secundi.</i>	317	F	70	$\frac{1}{2}$
Bloom ..	<i>Multi.</i>	363	M	50	11
Bounce (1) ..	"	343	M	15	$\frac{1}{2}$
" (2) ..	"	331	M	9	3
Mandolina ..	<i>Primi.</i>	349	F	15	2-7
Rita ..	<i>Secundi.</i>	332	F	23	2
Ruby ..	"	346	M *	10	10½
Rambler ..	<i>Primi.</i>	326	M	30	14-21
Kitty (1) ..	"	343	F	10	$\frac{1}{2}$
" (2) ..	<i>Secundi.</i>	346	M	70	16

* Died.

tion. To develop the latter point: it is very improbable that by the introduction of a sulphonamide in powder form into the body of the uterus that it will eventually come everywhere into contact with the infected mucus membrane of the body and cornua. It is unlikely to become hydrolysed in the uterus and, moreover, its bacteriostatic action is greatly reduced by the presence of pus. For penicillin to be effective by topical application will necessitate frequent injections.

Sulphonamides should be administered into the stomach, using the stomach tube for preference. Dosage must be adequate, and in the case of sulphanilamide, 10 g. per cwt. bodyweight at least should be given as an initial dose (Stableforth, 1938). This may be repeated once daily for 2 or 3 days or continued by half doses twice daily. Penicillin is administered by subcutaneous injection. For a 10-cwt. mare the initial dose will vary from 2 to 4 million units, followed by $\frac{1}{2}$ million units at 4-hourly intervals during the day and 1 million units at night.

THE EWE

Retention of the foetal membranes is uncommon in the ewe and when it occurs the outcome of untreated cases is similar to that in the cow. Progressive putrefaction occurs and they ultimately fall away in from 5 to 10 days. It is unlikely that severe systemic ill-health or death will occur. It is customary for the shepherd to apply traction from day to day to those parts exposed. The author has observed Oxford Down-Border Leicester cross shearling ewes which were pregnant with twins, abort one of the foetuses at about 15 weeks of pregnancy and retain the membranes. These eventually fell away after putrefying. At term the ewes delivered normal lambs.

THE SOW

In the sow retention is fortunately rare, but when it does occur it generally gives rise to a fatal pyometritis. Normally the foetal membranes are generally expelled in two or three masses during or shortly after the delivery of the piglets. It is difficult to ascertain if expulsion has been complete because of the variety of forms the membranes may present. Often the allanto-chorionic sacs of a number of the foetuses anastomose and compose a cylindrical tube of allantois-chorion in which can be recognized the ruptured umbilical cords and amniotic sacs of four, five or even more foetuses. In other instances, two sacs only may fuse while sometimes a piglet has its own complete membranes.

Retention of part of the membranes is most likely to occur after

the pulse rate is within the physiological limits and food is being taken. The author has on several occasions administered pituitary extract in retention of 8-12 hours in doses of 8-12 c.c. by intramuscular injection with disappointing results. The onset of the drug's action became apparent in 15 minutes and persisted for about 30 minutes. There was severe abdominal pain; the animals going down and straining with the passage of flatus, but the membranes were apparently uninfluenced, for they were voided several hours later, by which time the action of the drug had ceased. The author is loth to make any attempt at manual separation of the membranes until he is satisfied that they are unlikely to be expelled normally, for he believes that by so doing there is a grave risk that the uterine epithelium will be broken, the capillary loops in the crypts opened and foci for the entry of bacteria established.

Nevertheless he is of the opinion that after a lapse of 24 hours or more, the time for interference has arrived. Adopting scrupulous cleanliness, the hand is introduced into the vagina and the lacerated edges of the allantois-chorion picked up. In many cases portions will already occupy the vagina. Gentle traction is applied. The twisting of those parts detached into a "rope" facilitates even traction, reduces the tendency of the membranes to tear and often provokes detachment of the placenta in front of the point of traction. In many cases such treatment allows the membranes gradually to be drawn away. When, however, it is found that attachment, particularly in the distal parts of the cornua, is firm, great care must be taken that the portions already detached are not torn away. If it is impossible to remove the membranes by this relatively simple interference, attempts should cease for the time being and be recommenced some 4 hours later, by which time it is highly probable their complete removal will be effected.

Prolonged retention is more serious in the mare than in the cow. The presence of putrefying membranes in the uterus is likely to cause severe metritis with acute toxæmia and even septicæmia, moreover, such metritis is especially liable to be complicated by laminitis.

In the past the introduction of pessaries into the uterus has been the most popular form of treatment of puerperal metritis, and the whole gamut of antiseptics and adsorbents has been used. Douching of the uterus is generally looked on with disfavour because of the impossibility of subsequently removing the fluid introduced. The introduction of the sulphonamides and of penicillin, however, has opened up new vistas in the treatment of metritis in the mare. They may be used singly or in combination and internal administration is preferable to local applica-

firm pressure should be applied to the distended part of the uterus. It is likely that by so doing separation will be effected and the placenta immediately expelled. At the same time gentle traction to any parts of the cord present at the vulva is helpful. If such treatment fails on the first occasion, it should be repeated after a few hours.

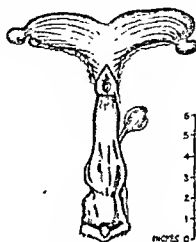


FIG. 218A.—GENITALIA OF A 30-LB. BITCH 24 HOURS AFTER PARTURITION SIX FŒTUSES.
(*Veterinary Record.*)

In the bitch also, if there is any doubt regarding the expulsion of the terminal placenta half an hour or so after the last foetuses have been delivered, pituitary extract should be given. In the case of valuable toy bitches the veterinarian may well insist that the bitch shall be attended throughout the whole of her labour and that she shall be prevented from eating the placenta, but that they shall be collected for subsequent inspection.

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 Wright, J. G. (1943). *J. comp. Path.*, 53, 212.

protracted labour, and thus in all assisted deliveries the membranes expelled should be examined and by counting the remnants of the umbilical cords a reliable opinion formed as to whether or not expulsion is complete. In all cases of prolonged labour the administration of pituitary extract (3 c.c.) is recommended.

By the time a retention case has become noticeably ill with inappetence, a rise in temperature and a sanguino-purulent discharge from the vulva, the cervix has contracted to a degree whereby it is impossible to pass the hand through it, and the veterinarian is unable to give useful assistance. On several occasions in such cases the author has attempted to dilate the cervix with the animal under general or epidural anæsthesia, without success.

THE BITCH

In the bitch also retention of the membranes is rare. Nevertheless, on occasion one or both of the placenta occupying the apices of the cornua are retained. The accident most often occurs in the "toy" breeds, particularly when the litter has been large and labour long. Unless the condition is relieved early, either naturally or by assistance, it generally proves fatal. The author has performed several autopsies on Pekingese bitches which have died 4 or 5 days after whelping to find peritonitis resulting from necrotic perforation of the uterine wall at the site of an attached placenta.

The nature of the vulval discharge in the immediate postparturient period affords evidence of retention. The dark green, mucoid discharge which is a feature of the second stage of labour in the bitch quickly ceases after the membranes have been expelled and in the course of the next 12 hours changes to a blood-tinged, mucoid discharge. If it is noticed that the green discharge persists 12 hours or more after delivery of the last foetus, retention of a placenta should be suspected. In such a case vaginal exploration with a finger may detect an umbilical cord, and by "fiddling" it may be possible to bring its end out of the vulva. Gentle traction may result in the withdrawal of a placenta; if it does it is likely that separation had already occurred and that its spontaneous expulsion was imminent. More often, however, gentle traction fails and if vigorous effort is applied the cord is torn away.

In any case, the uterus should be palpated through the abdominal wall. In a comparatively small bitch it is usually possible to detect the retained placenta in the uterus for it forms an egg-like distension in the otherwise contracting organ. With the fore-parts of the bitch raised,

believed to be free from that infection and in cows whose bloods are negative.

Clinical Features. The animal has been mated and has since been anæstrous. It is possible that early pregnancy has already been established by veterinary examination. In the case of primigravida the attendant may have noted commencing mammary and teat hypertrophy. Later he becomes suspicious that all is not well because this development does not continue and professional advice is generally sought some 8 months or so after mating. In dry cows term approaches, but there is no sign of the animal "bagging up." Frequently the time of normal parturition is several weeks past before advice is sought.



FIG. 219.—BOVINE FŒTAL MUMMY.

Specimen removed by hysterotomy from a multiparous Guernsey, 16 months after service. Labour had existed for about 8 hours at time of operation. Approximate age of fœtus at time of death, 8 months. Note disposition of umbilical cord across fœtal neck.

The duration of retention of the resorbed fœtus varies. In some cases it is expelled from the uterus at or shortly after the normal term. In others it is retained for much longer periods. In the author's series, 8½ months after the normal time for parturition is the longest. But in many instances the cow retaining a fœtus is destroyed because she has ceased to be profitable, and the evidence as to how long she might have retained it is lost.

In all cases of mummified fœtus *in utero* seen by the writer at post-mortem examination, a persistent functioning corpus luteum is found in an ovary, and in those instances in which he has had the opportunity of examining post mortem the genital organs of cattle which have expelled a mummy during the previous 14 days, a corpus luteum showing the same degree of ntrophy as occurs at a similar period after normal parturition was found.

CHAPTER 32

INTRA-UTERINE RETENTION OF THE DEAD FŒTUS

Fœtal Mummy

INTRA-UTERINE death of the fœtus with progressive resorption of its soft tissues, resulting in the so-called mummified fœtus, occurs in all species. It is of the greatest significance in dairy cattle, in which its occurrence is relatively common. For mummification to occur it is necessary that the uterus shall not become invaded by putrefactive organisms, and this is dependent on the cervical canal remaining closed and sealed. The condition also occurs in the mare, but is rare. Sometimes in the mare pregnant with twins, one dies and undergoes resorption and is expelled with the normal foal at parturition. In the multiparous species, one or more of the fœtuses may die and undergo a degree of resorption while the remainder of the litter continues to develop normally. In this instance the resorbed fœtuses are expelled at parturition. In other cases, particularly when the number of the litter is abnormally small (one or two only), all the fœtuses may undergo resorption and be retained in the uterus indefinitely (Fig. 42).

THE COW

The condition may occur in any breed and in primigravida or multigravida. Clinical experience indicates that it is more common in the Channel Island than in other British dairy breeds. Williams (1943) regards detachment of the placenta due to interplacental hæmorrhage (hæmotic mummy) to be the essential cause. The author has observed two cases in which it was found that the amniotic part of the umbilical cord crossed over the fœtal neck, and the degree of tension resulting therefrom was such as to cause a deep depression in the neck tissues. Both were large fœtuses of 8-9 months' development. In these accidental obstruction of the fœtal circulation was the probable cause. In the majority of cases, however, fœtal death occurs between the 4th and 6th month of gestation, when it is about the size of a rabbit. Not infrequently the blood serum of affected animals agglutinates *Br. abortus* antigen in positive titres, and, in fact, Bang succeeded in isolating that organism from two mummies. Nevertheless, the condition often occurs in herds

TABLE 13.

Stilbæstrol in the Treatment of Retained Fœtal Mummy

Animal	Time after term when treatment given	Dosage	Result	Reporter
Guernsey, 6 y.o.	2 months	25 mgm.	8 c.c. pituitary ext. at 50 hrs. 6-inch fœtus expelled at 60 hrs.	Stuart (1942).
Guernsey-Shorthorn, about 6 y.o.	2 "	25 mgm.	20-inch fœtus expelled 5½ days later.	Stuart (1942).
Shorthorn X, about 4 y.o.	4 "	25 mgm.	Fœtus expelled	Powell (1942).
Jersey, 2½ y.o.	2½ "	25 mgm. 25 mgm. 4 days later 30 mgm. 7 " " 50 mgm. 14 " " 75 mgm. 17 " " 100 mgm. 20 " "	Fœtus not expelled	Anderson and Bugg (1942).
Friesian, aged.	—	20 mgm. 15 mgm. 24 hrs. later	After 48 hrs. cervix had dilated; fœtus removed by hand.	Weighton (1943).

for the purpose, but he has himself successfully removed a diseased ovary by flank laparotomy. Cæsarian section in the treatment of retained mummy is discussed on p. 321.

Macerated Fœtus in utero

This condition must be distinguished from the preceding one. It comprises the presence in the uterus of a fœtus, of about 5-7 months' development, undergoing putrefactive maceration. The fœtal soft tissues liquefy relatively quickly and a mass of fœtal bones remain in the uterus. The majority of such cases appear to be incomplete abortions, for there is generally evidence that signs of impending abortion had been observed. There is a continuous mucopurulent vulval discharge and vaginal examination reveals the cervix to admit the passage through it of

The primary factor in the expulsion of the mummy would appear to be the onset of functional regression of the corpus luteum. The time of onset of the first visible heat after expulsion varies. It may occur as early as 2 days but more often is delayed for 14-21 days.

Diagnosis is based on the history of the case and the findings on rectal examination. In the majority, it is possible to palpate the gravid cornu and detect in it the outline of the resorbed foetus. In others, while the outline of the foetus may not be detectable, the enlargement and solidity of the affected cornu is recognized. It is possible but unlikely that the ovary on the gravid cornu will be within reach of the hand. It will be enlarged due to the presence in it of a corpus luteum. In cases in which foetal death has occurred late in pregnancy, the part of the uterus containing the foetal remains may be beyond and below the reach of the hand. In these the drag of the cervix over the pelvic brim will be detected and failure, on repeated examination, to palpate a normal foetus, particularly at term, is helpful. In some of these it is possible to ballotte the foetus through the abdominal wall. For certainty of diagnosis in cases in which the foetus is beyond the reach of the hand by rectal examination and in which ballottement fails, the animal should be examined *per rectum* after casting it and restraining it on its back when the weight of the foetus in the uterus causes it to fall on to the hand.

Stuart (1942) was the first to record the successful use of stilbæstro-dipropionate in oil by subcutaneous or intramuscular injection in the treatment of retained foetal mummy.

The explanation given for the drug's action (Brownlee, 1942) is that by raising the oestrogenic level of the blood, regression of the corpus luteum is initiated and with the consequent fall in the progesterone level, relaxation of the cervix occurs and the uterine musculature becomes sensitized to the whipping action of oxytocin.

In those cases in which stilbæstrol fails to cause expulsion, it may with wisdom be decided to do nothing other than await natural expulsion. There has been speculation as to the likely value of manual expression of the corpus luteum *per rectum*. It may, however, be taken that as was the case in advanced pregnancy, expression of the corpus luteum in cases of retained mummy is an impossibility if reasonable and controlled pressure only is to be used. It may be thought advisable in a valuable dairy cow in which other methods have failed, surgically to remove the ovary or, better still, excise the corpus luteum from the ovary by high flank laparotomy. The author knows no record of this having been done

CHAPTER 33

PERINEAL DEFORMITY CONSEQUENT ON RUPTURE AT PARTURITION

THIS condition is relatively common in the cow, and in the author's experience the Friesian is the breed most often involved. In the mare the more common injury is recto-vaginal fistula, the perineum and labiæ remaining intact. In the mare also chronic pneumo-vagina is more often the result of abnormal cooformation of the vulva or debility than of injury (p. 440).

Götze estimates that in Germany some 25,000 to 30,000 animals are affected yearly, and of these 75 per cent. prove useless for breeding. In England the incidence is certainly much less and of the animals affected the percentage permanently sterile is less also. The author is familiar with many cattle with perineal deformity the result of injury, which breed normally.

Infertility is linked with the development of chronic pneumo-vagina and the vaginitis which results therefrom and if this does not occur it is likely that the animal will continue to breed. Pneumo-vagina is the outcome of the drawing forwards into the pelvic canal of the deformed dorsal commissure of the vulva and the fact that it lies above the vulvo-vaginal floor. In this way the valve-like mechanism of the vulva breaks down, the upper commissure remains open and air passes into and out of the vagina. The vagina is continuously ballooned and there is considerable muco-purulent exudation.

Vulval injuries at parturition should if possible be dealt with at once, for provided there is no gross infection, i.e. the foetus which caused them was a healthy one, results are good. Under epidural anæsthesia, which has the added advantage of checking defæcation, appropriate suturing both of the depth and of the superficial edges of the rupture should be performed. The degree of injury may vary from complete rupture of the partition and involving the anus in addition, to variable degrees of tearing of the upper commissure with connective tissue and muscle beneath. If, however, 48 hours have elapsed before aid is sought, it is better that the lesion be allowed to heal and cicatrize before operation is considered.

one or two fingers. Not infrequently the bony remains of the fœtus in one of the cornua can be felt with the finger. *C. pyogenes* is found in the discharge. On rectal examination enlargement of a cornu, generally to a width of 4-5 inches, can be detected, and on squeezing it grating of the bones is felt.

In the author's series of cases the affected animal has been anæstrous and when opportunity has arisen to examine the ovaries post mortem they have been found to be functionless. Often, however, such cases have been vigorously treated with stilbœstrol and in these the ovaries may be found to be cystic. Colleagues have spoken of cases in which the animals were showing recurrent œstrous cycles.

A striking feature of the condition is that affected animals seldom show any general departure from health.

No useful advice as to treatment can be offered. The author has attempted, under epidural anæsthesia, to dilate the cervix to a degree sufficient to admit passage of the hand through it, but has failed. He has performed laparotomy with the object of removing the fœtal remains by hysterotomy, but was unable to bring the uterus to the abdominal wall. He has provoked lactation in affected heifers by the subcutaneous implantation of stilbœstrol in the hope that this might cause the cervix to relax, but this also has failed. Luteinizing hormone also has been used without effect. Attempts to remove the fœtal bones by "picking" with one or two fingers through the cervix are dangerous, for there is a grave risk that by so doing the uterine wall will be punctured and this will probably be followed by a rapidly fatal peritonitis.

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Reynolds, A. (1942). *ibid.* 54, 107.

Ithaca, New York.

15,"

Operation is performed in the standing position under epidural anaesthesia, 8–12 c.c. of 2.25 per cent. procaine hydrochloride solution, according to the size of the cow, being injected at the first intercoccygeal space. With vulsellum forceps attached to either side in order to tense the tissues, an incision is made into the scar tissue on each side of the adventitious aperture (Fig. 221). The mucosa of the roof and walls of the abnormal orifice is then dissected away forward for a distance of $1\frac{1}{2}$ –2 inches, taking care to leave a strong rectal floor (Fig. 220). Next, by means of vulsellum forceps, the floor of the rectum is pulled backwards and, using a full-curved needle and needle-holder, the wound is closed from its depth with catgut sutures (Fig. 222), taking care not to penetrate the rectum. The skin wound is closed by mattress sutures of catgut or nylon.

Prognosis is good. Despite the passage over it of faeces the wound usually heals without complication. Pneumo-vagina ceases and the vaginal inflammation resolves.

OPERATION FOR RECTO-VAGINAL FISTULA (FIGS. 224–229)



FIG. 224.

The existing partition between anus and vulva is incised.



FIG. 225.

Retraction of the lips of the wound after incision of the partition.

Götze has described in detail the operation for reconstruction of the deformed perineum, and it is this, with slight modifications to meet individual cases, which the author adopts.

RECONSTRUCTION OF THE BOVINE PERINEUM (FIGS. 220-223)

(After Götze)

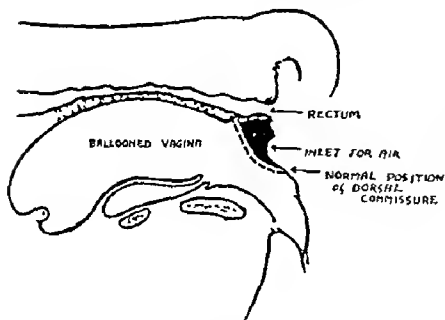


FIG. 220.

Area of scar tissue—black.
Lines of incision and tissue to be excised marked by dashes.

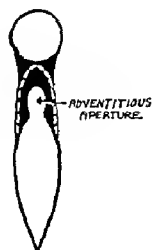


FIG. 221.

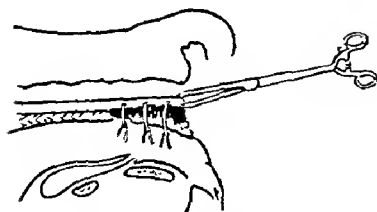


FIG. 222.

Ventral wall of rectum drawn black.
Section of raw area—shaded.
Position of deep sutures indicated.



FIG. 223.

Closure of superficial wound.

prevent the entry into it of faeces for a sufficient time for resolution to occur. To obtain success it is essential that a considerable area of scar tissue and of vaginal mucus membrane on either side of the ventral



FIG. 228.

The vaginal roof is closed by interrupted sutures.



FIG. 229.

Suture of the perineal wound.

opening of the fistula shall be removed in order to give support to the sutures. The method adopted by the author is illustrated by figures 224-229. It will be noted that to make the rectal floor and vaginal roof accessible for suturing the intact perineum is first incised.

REFERENCE

Götze, R. (1938). *Dtsch. tierärztl. Wschr.*, 49, 163.

Recto-vaginal Fistula

This sequel to parturition is more common in the mare than in the cow. In the former species it generally results from perforation of the dorsal vaginal by an abnormally presented digit which has been replaced by veterinary assistance before rupture of the anus has occurred, while in the latter it generally is the outcome of a gross perineal tear during delivery of an oversized fetus involving vaginal



FIG. 226.

Vaginal mucous membrane and scar tissue is removed over a considerable area beneath the fistula on either side.



FIG. 227.

The aperture in the rectum is closed by a series of sutures which include the mucosa and a considerable depth of the freshened areas.

roof and anus in which, consequent on suturing, the skin has healed but the internal communication persists. The chronic vaginitis which results from continuous contamination of the mucous membrane by feces generally renders the animal sterile. In the mare the extent of the fistula may be such that the vagina becomes entirely filled by feces and it becomes necessary manually to empty the organ daily.

Successful operation is by no means as easy as in the previous condition. It is difficult to maintain closure of the fistulous track and thus

The signs of the condition are obvious. As a rule the affected animal is recumbent, but occasionally it is standing with the everted organ hanging down almost to its hocks.

Prognosis

The prognosis will depend firstly on the type of case, secondly on the duration of the condition before treatment is forthcoming, and thirdly on whether the organ has sustained severe injury. Nevertheless, as the condition is generally encountered, that is, as a sequel to a normal parturition, and professional assistance is forthcoming within an hour or two of its occurrence, the prognosis is good. Replacement of the organ does not offer insurmountable difficulties and recurrence after replacement is uncommon. Moreover, such animals generally conceive again. Not infrequently an animal which has everted her uterus at one parturition, calves subsequently without trouble, in fact, repetition of the condition is the exception rather than the rule.

Occasionally prolapse of the uterus is followed in a matter of an hour or so by the animal's death. On post-mortem examination in such cases it is found that death was due to internal hæmorrhage consequent on the weight of the everted organ having torn the mesovarium and the ovarian artery. Even in those cases in which there has been delay and in which the endometrium is grossly contaminated and deeply congested, the prognosis is not hopeless, for the recuperative powers of the organ are quite astonishing, and thus when dealing with dairy cattle amputation of the everted organ should only be considered when injury is gross and when resolution is clearly impossible.

Treatment

Replacement of the Everted Organ. On notification of the case, the farmer should be instructed to wrap the prolapsed viscus in a large towel or other suitable material to prevent further contamination, if, as is likely, the cow is recumbent; and if she is standing, to support the organ by a large towel or sheet held by men on either side, until professional assistance is forthcoming. In the past, the chief difficulties in replacement of the organ have been associated with the almost continuous straining which manipulation of the uterus provokes and to the fact that pressure had to be applied in an uphill direction. Numerous methods of overcoming these difficulties have been introduced—the tension of a rope around the posterior abdomen, raising the animal's hind parts on boards or on a truss of straw, or even casting her and

CHAPTER 34

POST-PARTURIENT PROLAPSE OF THE UTERUS

PROLAPSE of the uterus is a common complication of parturition in the cow and in the ewe. It occurs less frequently in the sow, and is rare in the mare and bitch. In the ruminant species the prolapse is generally a complete inversion of the gravid cornu, while in the sow and the bitch inversion is generally partial and comprises one cornu only. Cases are on record in which the bitch has everted one cornu before she has completely delivered the fetuses from the other. In the mare the rare cases of prolapse are generally partial only.

THE COW

Multigravida are more often involved than are heifers. In the majority of instances the prolapse occurs within a few hours of an otherwise normal parturition, although in some it may be delayed several days. In the latter group the condition is generally associated with a grossly protracted and assisted labour.

Etiology

It is of interest to note that in most cases the foetal membranes are completely or partially attached to the uterine caruncles at the time of the accident, and having regard to the fact that during the normal course of their expulsion the foetal membranes undergo inversion, it would seem probable that owing to some excessive contraction at the apex of the gravid cornu, that inversion of that organ also commences and having commenced goes on to completion under the influence of peristaltic contraction. It is significant to note the observation of Vinattieri *et al.* in India that the post-parturient injection of stilbæstrol had caused prolapse of the uterus in the buffalo. In Australia also prolapse of the uterus is a feature of the disease caused in sheep by excessive feeding on clovers containing æstrogenic hormones. In those cases in which the onset of the prolapse is delayed several days it is likely that purely mechanical factors are responsible, prolapse resulting from the pressure of the abdominal viscera on the inert and flaccid organ during straining.

ring, and to ensure this the operator locates the margins of the dilated cervix and draws them towards him, and if possible, at the same time pushes the uterus in a forward direction with the other hand. In some cases it may be found helpful to grasp the cervical ring at several points in succession and with a piston-like movement of the hand and arm insinuate the uterine mass through it. When this has been accomplished the cervix should lie unoccupied at the level of the pelvic brim and if the whole uterus has passed the cervix it will promptly regain its normal position.

A final advantage of epidural anaesthesia is that for an hour or so after replacement of the organ any tendency to strain will be removed. It has been customary in the past to insert a large pessary in the vagina after replacement and also to insert vulva sutures. It is unlikely that these practices serve much useful purpose. Many practitioners recommend the application of a tightly placed rope truss for 2 or 3 days. In uncomplicated cases it is generally found that within 24 hours of replacement the degree of cervical contraction present is such that recurrence is very unlikely.

Amputation of the Everted Organ. This operation is adopted as a last resort in those cases in which the uterus has undergone such severe changes that replacement of the organ must inevitably result in death. The prognosis is grave, its gravity being due not only to the magnitude of the operation but also to the severity of the case which prompts its adoption. Nevertheless, there are many records of recovery and it has been possible to fatten the animal for the butcher. Operation, which is performed under chloral hydrate narcosis and epidural anaesthesia, comprises the application of a stout transfixing and encircling ligature immediately behind the region of the cervix and the subsequent excision of the prolapsed mass about 3 inches posterior to the ligature. For ligaturing, stout whipcord or elastic is generally used, encircling the mass three or four times and tying off after each encirclement. The ligature should be applied as tightly as possible for it is necessary that it shall occlude not only the blood vessels in the uterine wall but also those present in the broad ligament which lies in the lumen of the everted organ. Amputation may be carried out with a knife or with the actual cautery. Clearly it is essential that none of the abdominal viscera shall occupy the interior of the prolapse, but accurate determination of this may be extremely difficult, for the size and density of the organ prevents any exact assessment by manipulation of what lies within it and thus most operations are carried out in the dark in relation to this factor.

raising her hind parts by means of a block and tackle hooked to a figure-of-eight rope around the hocks. But these difficulties have been almost entirely overcome by the introduction of epidural anaesthesia, and its adoption in these cases should now be routine. The quantity of local anaesthetic used should be such that the animal is just able to maintain the standing position, for replacement of the organ is greatly facilitated by this position. This will entail quantities of from 8 to 12 c.c. of a 2-2.5 per cent. procaine hydrochloride solution injected into the epidural canal at the first intercoccygeal space. Not infrequently an animal which has been recumbent will regain her feet voluntarily after the induction of anaesthesia, or she can, as a rule be stimulated to do so.

A further advantage of epidural anaesthesia is that defaecation is in abeyance during operation. The everted organ should be thoroughly washed with warm normal saline solution. If the foetal membranes are already partially detached and their complete removal can be carried out easily and without injury to the caruncles, this should be done. But when attachment is complete or when attempts at detachment are associated with hæmorrhage, it is better that the organ be replaced with the membranes still adherent. The subsequent management of the retained foetal membranes should be on the principles outlined in Chapter 30.

The prolapsed organ should be palpated in order to detect the possible presence within it of a distended urinary bladder, and if such is the case, it should be relieved by the use of a catheter. The uterus should be supported by assistants holding the corners of a towel beneath the mass or upon a piece of board some 3 feet long covered by a clean cloth or towel. Smythe (1948) describes the operation of replacement as follows:

Having well soaked his hands, the operator commences to replace the uterus little by little, starting with those portions nearest the vulval lips. By gentle pressure the nearest cotyledons are pushed into the vagina, taking care that the lips of the vulva remain well apart and do not become turned inwards. It is generally best to replace portions of the upper and lower surfaces alternately. When the last portions only remain to be replaced, an assistant should press against these, using the palms of both hands, while the operator endeavours to draw the lips of the vulva over the prolapse. As the mass disappears through the lips of the vulva the operator, using his clenched fist, should then continue to press it forward to the full length of his arm. It is important that the uterus should be pressed forwards beyond the cervical

CHAPTER 35

INFERTILITY

INFERTILITY among farm animals is one of the great economic problems which confront the veterinarian. It is particularly widespread among dairy cattle, but is of lesser significance in the beef breeds. In the sheep, goat and pig, the condition is not a major cause of loss. In horse-breeding studs, particularly of the English thoroughbred, infertility is a major problem. In the dog and cat it is relatively unimportant.

The causes of infertility are numerous, varied and complicated, for so many factors are concerned in successful reproduction: the development of the graafian follicle to maturity, the onset of heat, fertile coitus, the expulsion of the ovum from the follicle, its arrest by the fimbria and its meeting in the pavilion of the oviduct with a swarm of virile spermatozoa, its passage along the oviduct—there undergoing segmentation; the implantation of the morula in the endometrium, the progressive development of the fœtus and its membranes, and finally the expulsion of the full-term fœtus with its membranes from the uterus. Should this mechanism break down at any point, perfect reproduction will fail and the animal become, if only temporarily, infertile.

The causes of sterility may be congenital or acquired and the condition temporary or permanent. Even temporary infertility may be the cause of great loss due to wasted breeding time and loss in milk yield.

The cause of infertility more often lies in the female than in the male.

GENERAL REVIEW OF THE CAUSES OF FEMALE INFERTILITY

Congenital Factors

Under this heading are included developmental abnormalities of the genital organs—intersexuality, vaginal deformity, the bovine “free-martin” and the “white heifer” of the shorthorn breed. Such factors, however, represent only a very small proportion of infertile animals and in those cases where heredity is the cause, the condition should be eliminated by selective breeding on genetic principles.

Fortunately, it is only rarely in the bovine that this complication arises. Having removed the organ, the vagina is replaced through the vulval lips into the pelvic canal. Operation may be followed by severe and continuous straining. If this is serious it is well to induce epidural anaesthesia daily for three or four days after operation.

OTHER SPECIES

In the ewe the operation of replacement is similar to that described for the cow except that it is easier to perform because of the facility with which the hind parts of the ewe can be kept raised. In the ewe, however, there is a greater tendency for the condition to recur. Vulval sutures are quite ineffective in preventing such recurrence and if they have been inserted it is likely that extensive tearing of the perineum or the lateral parts of the labiae will result. Epidural anaesthesia, although more difficult to induce in the ewe, is a great advantage in that it controls straining for an hour or so. In cases of recurrence it may be decided to amputate the uterus, but here again there is a variation from the cow in that in the majority of instances small intestine occupies the interior of the prolapse. Thus, operation should be performed with the ewe held in the vertical position with her head downwards and after careful squeezing of the everted organ to return to the abdomen any intestine which might occupy it.

In the sow and the bitch, replacement of the everted cornu is generally impossible and amputation is indicated. Operation may be performed under general or epidural anaesthesia. The prognosis is more hopeful in the bitch than in the sow.

The author has had no experience of the condition in the mare and records of it are few. It would seem that the best procedure would be to attempt replacement of the organ in the cast position under deep chloral hydrate narcosis with epidural anaesthesia in addition, although Firth (1947) reports a case in which complete prolapse occurred 24 hours after parturition in a multiparous cart mare whose foaling had been normal. The organ was successfully returned without great difficulty, the mare being placed on a bank with her fore parts downwards and the uterus returned in the manner employed in the cow. Chloral hydrate by mouth was given before and after operation, and recovery was uneventful.

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Smythe, R. H. (1948). Private communication.

Neoplasia of the bovine ovary may be associated either with a reduction or an exaggeration of heat, in fact an individual animal so affected may be anœstrous in the early stages of the lesion and nymphomaniac later. It is of interest that the diseased ovary appears to be dominant over the other one which generally remains small and functionless.

Inappropriate Mating Time

In those species, such as the mare, in which the period of heat is comparatively long, a single mating early in the period may prove infertile, due to the death of the spermatozoa before ovulation has occurred. Certain individuals in those species having short heat periods such as the cow, may exhibit exceptional delay in ovulation and in these also a single, early mating may fail.

Failure of the Fertilized Ovum to Develop

The fertilized ovum may perish during the early stages of development (Laing, 1949). The causes of this early death are not known; they may lie in inherent weaknesses in the ovum or the spermatozoon which fertilized it. It is probable that this factor is of greater significance in the bovine than has previously been appreciated.

Abortion of the Partially Developed Fœtus

In cattle, the roles of specific infections such as *Br. abortus* and *T. fetus* in the causation of abortion are well recognized, as also is that of *Bact. abortivo equinus* in the mare, but there are many other causes of abortion the exact nature of which is not understood.

Intra-uterine Death and Retention of the Fœtus

This condition is encountered in all species. The retained bovine foetal mummy is well recognized. Partial resorption of some of the foetuses is common in the pig and bitch, while occasionally mummification occurs in the mare and ewe. The causes of the condition are often not understood, but there is evidence in the multiparous species that genetic factors are responsible.

Endocrine Dysfunction

This is probably the most important cause of infertility in animals.

Lowness of the Heat Plane. Despite the fact that the ovaries are undergoing their normal cyclical changes, the manifestations of heat

Temperamental Factors

Refusal to mate due to temperamental factors is uncommon in the female with the exception of the bitch. (It may be a significant factor in the bull.)

Acquired Anatomical Factors

These include deformity of the vulva, vagina or uterine cervix, the outcome of injury or debility; the development of neoplasms in some part of the genital tract; adhesions of the ovaries to the ovarian bursæ; and cicatrization of the bursæ with strangulation of the oviducts.

Neoplasms

Neoplasia of the genital organs must be reviewed in discussing the causes of infertility in animals. The most frequent focus is the vulvo-vagina. In the bovine vulval papillomata are relatively common and



FIG. 230.—A CYST-ADENOMA OF THE OVARY OF THE BITCH. CONTINUOUS (ESTRUS).

they may attain a size which prevents coitus. In the bitch, vaginal myxofibroma is common while venereal granulomata are occasionally seen in England. The cervix is only rarely a focus of neoplasm in animals. The author has seen sarcoma of the cervix in the bitch and lymphoblastoma (associated with the generalized condition in the body) in the cow. The uterus also is rarely involved in neoplasm formation. Multiple lymphoblastomata have been observed in the cow, as also has leiomyoma in the bitch. The ovaries are more frequently involved. In the bovine malignant thecoma, cyst-adenoma and lymphoblastoma have been seen, and in the bitch sarcoma and cyst adenoma.

been regarded as a diseased condition is a physiological hypertrophy of the organ.

The Vagina. Specific infections occur such as coital exanthema in cattle and mares. Vaginitis may also be the outcome of previous injury particularly when chronic pneumo-vagina develops. In cattle a granular vaginitis has long been held to be a cause of infertility, but it is probable that the condition so described is a nodular lymphoid hypertrophy; it is sometimes seen in *trichomonos fetus* infection. The infective vaginitis of cattle which occurs in E. Africa is unknown in England.

REFERENCE

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are slight or even entirely absent. This form of infertility is increased by the segregation of the sexes and by continued housing. It is a serious problem both in cattle and mares.

Irregularities in Ovarian Function. There is a tendency to over-simplify the irregularities in ovarian function which occur in the cow and the mare and to classify them in watertight groups. The introduction of hormone therapy has fostered this. Imperfect ovarian function may result in:

Failure of Follicles to Develop. The ovaries remain small and functionless and there is an absence of heat. The condition is often seen in the bovine and dog.

Failure of Follicles to Rupture. Follicles develop to a size often exceeding that at which they normally ovulate and persist as such. In some cases luteinization of the follicle wall occurs while in others there is no evidence of lutein tissue. The condition may be associated with an absence of heat, irregular heat manifestations or nymphomania. It may be temporary or permanent. This condition is generally described as "cystic ovaries" and is common both in the bovine and the horse.

Persistence of a Corpus Luteum in the Absence of Normal Pregnancy. This is met chiefly in the bovine. It is accompanied by an absence of heat and by changes in the uterus. The most common of the latter is pyometra, but others are cystic hypertrophy of the endometrium and the presence of a resorbed fetus *in utero*.

Infections of the Genital Organs

The Uterus. The endometrium may be the focus of specific infections such as tuberculosis, brucellosis and trichomoniasis. These are essentially bovine diseases. Recently, infections of the uterus by *Vibrio fetus* and by pleuro-pneumonia-like organisms have been incriminated in bovine infertility. The uterus may also become involved in pyogenic infections causing chronic metritis or pyometra, but these conditions are generally linked with some other abnormal factor of physiological or anatomical origin. They require discussion in relation to the species of female involved.

The Ovaries. Tuberculosis is the chief infection of the ovaries and the bovine is the species essentially concerned.

The Oviducts. Again, tuberculosis is the most common infection, but occasionally pyogenic forms also occur.

The Cervix. Although "cervicitis" has long been accepted as a cause of infertility, its existence is questionable and it is likely that what has

sidering this aspect of infertility, the human factor in animal husbandry must not be lost sight of, for there are great variations in the ability of cowmen to recognize heat signs. Some are amazingly efficient and are able to detect the slightest change in the behaviour of their charges, but from this peak of efficiency there are marked downward gradations. Needless to say, the condition is much commoner in the winter when the animals are housed and are given no exercise, and there is no doubt that many of the animals included under this heading would have shown recognizable signs had they been at grass, and if they had been running with a bull would have been mated. But despite such precautions as allowing cows to run out in a yard daily or walking the bull through the cowshed, many animals will be met in which the sexual urge of oestrus is absent.

The discovery by Bennetts and his co-workers of the presence of oestrogenic substances in certain clovers in Australia throws a new light on the subject. It possibly explains the tendency which cattle showing absence of heat in the winter, when housed and fed on dried food, have to return to normal periods again when turned out to grass in the early summer.

The clinical features of the condition vary. Heifers may attain sexual maturity and show no heat cycles. Cows after calving may go several months without return to visible oestrus, while others show heat only at long and irregular intervals. A cow after parturition may show one or two heat cycles and then relapse into a prolonged state of sexual quietude. When such an animal has been served but has failed to conceive, a sense of false security arises, for attention to her is relaxed and months may elapse before she is "seen" again. In an ordinary commercial herd such an animal may by this time have ceased to be an economical proposition and when dry is disposed of to the butcher.

In the majority of cases no abnormality of the tubular portion of the tract is discovered and in these the condition is classified according to the ovarian findings as:

Suboestrus (Murray, 1943) or "Silent Heat"

A series of rectal examinations indicates the ovaries to be undergoing their normal cyclical changes. (On a number of occasions in which the findings on rectal and vaginal examinations have been typical of those of oestrus, the author and his colleagues have successfully artificially inseminated the animals.) It is highly probable that many of the cases referred to in the past as "persistent corpus luteum" were in fact

CHAPTER 36

INFERTILITY IN THE COW

THERE have been two prominent and divergent schools of thought regarding the primary focus of abnormality in the common acquired forms of sterility in cows.

Swiss workers (Hess and his colleagues) held that ovarian abnormality was the primary condition—cystic degeneration of the graafian follicles; persistence and cystic degeneration of the corpus luteum. They introduced the method of treatment which comprised rupture of cysts and expression of corpora lutea.

The Danish school (Albrechtsen, Nielsen and others) formed the conclusion that the primary cause was infection of the tubular portion of the tract, particularly the uterus, by pyogenic organisms and that ovarian changes were secondary. The main feature of their treatment comprised medication of the uterus.

During the last generation interest in the subject has been world wide and a voluminous literature has developed. The generally accepted view has been that infection is the more important factor. In this country, the Survey Committee of the National Veterinary Medical Association, which was formed during the early days of the Second World War, came to the conclusion that most cases were due to varying degrees of endometritis and one of its chief recommendations was irrigation of the uterus by the Danish method. It is the author's belief that this view now requires considerable modification.

The recognition of Trichomonas fetus infection was a milestone in our knowledge, and there can be little doubt that some of the confusion of the past was due to the non-recognition of this disease for now that its nature is appreciated, the apparently opposing views of early workers become in measure reconciled.

ENDOCRINE DYSFUNCTION

Absence of Visible Heat

Probably the most common breeding irregularity in cattle is the absence of detectable signs of *œstrus* in non-pregnant animals. In con-

enucleation may be difficult. As regards time, the 8th-12th day in oestrus is the optimum. During the early part of the period the size of the corpus luteum is insufficient for it to be greatly influenced by general pressure on the ovary, while towards the end the serosa over the protrusion is becoming invaded by scar tissue which gives it support.

By rectal palpation the ovaries are detected and their size and consistency assessed. The one containing a fully developed corpus luteum is generally distinctly larger than the other and instead of being flattened from side to side is "plum-like." It may or may not be possible to detect the protrusion. The ovary is picked up through the rectal wall during a period of relaxation of the latter, and firmly but gently pressed between the thumb and fingers. In the majority of cases the thin layer of epithelium over the corpus luteum readily ruptures and the structure "shells out." By continuing pressure and in addition applying a rubbing action, the yellow body is completely enucleated and falls into the abdominal cavity. Pressure on the ovary is continued for a further 10 seconds or so.

Expression of the corpus luteum in a pregnant animal will be followed by abortion; there is, however, relatively little risk of this accident occurring provided reasonable pressure only is applied to the ovary. It is difficult even when handling the ovaries of pregnant cattle on the post-mortem-room table to express the corpus luteum of pregnancy from the ovary by digital pressure after the second month.

The operation is not entirely free from danger to the cow, and cases are on record in which death due to hæmorrhage from the crater in the ovary has occurred. The author has never experienced such an accident, but he has had cases in which a large hæmatoma formed in the ovary after the operation.

(The induction of visible heat after uterine irrigation is discussed on p. 435.)

Anæstrus

Absence of heat due to functional quiescence of the ovaries. Rectal examination in such cases reveals the ovaries to be small and flat from side to side; neither a corpus luteum nor developing follicles being detected. At a second examination, made as a check, some 10-12 days later, the condition is unchanged. It is of the greatest concern in unbred heifers, especially those in poor condition. There appears naturally a period of sexual quietude after parturition, particularly when lactation is heavy, but when this continues longer than 3 months it should be

subœstrus, and the corpus luteum palpated was that of diœstrus, for in a random examination the chances are two to one that a corpus luteum of full development will be present.

The author is of the opinion that the practice of withholding service from animals which show heat with the object either of attaining higher record yields or of ensuring winter calvers is fraught with a risk that the outcome will be a considerable loss of breeding time due to the onset of sub-œstrus. High yielding cows may show one or two heat periods only after calving and then relapse into a quiescent state for several months. Again, mature heifers which have been showing regular cycles during the summer when at grass, may fail to show heat during winter housing.

Two forms of treatment are in vogue: the first, enucleation of the corpus luteum by digital pressure applied per rectum and the second, the intramuscular injection of an œstrogenic substance such as stilbœstrol dipropionate. The first is the more successful. Visible heat occurs in about 70 per cent. of cases in a period of 1-5 days after operation, and the conception rate at this induced heat is the normal one. In the majority of the remainder recurrent visible cycles develop.

Using stilbœstrol dipropionate in oil, in doses of 15-25 mgm., visible heat is induced in about 40 per cent. of cases in a period of 1-6 days. The percentage of conceptions at the induced heat is very low. In the majority of cases in which heat has been provoked, however, recurrent visible cycles develop. (The dosage of stilbœstrol is a subject requiring much more experimental investigation. The action of graded doses throughout the various phases of the heat cycle should be observed.)

Expression of the Corpus Luteum. This operation was introduced by Hess (1909) and later studied by Hammond (1927). If the corpus luteum is enucleated from the ovary about the middle of diœstrus, the onset of heat will occur in about 48 hours, but the duration of the induced heat will be only half that of a normal one. In practice, when the operation is performed at an unknown time in diœstrus, the onset of the induced heat occurs in from 1-5 days. There is plentiful evidence that ovulation occurs and if fertile mating is forthcoming, conception may ensue.

The facility with which the operation can be performed, apart from individual factors associated with the cow, will vary both in relation to the form of the corpus luteum and the time in the diœstrous period at which it is attempted. As regards the former; the greater the degree of protrusion from the surface of the ovary, the easier is expression. In those cases in which the protrusion is small and nipple-like, complete

Persistent Corpus Luteum

By this is meant the persistence of a functioning corpus luteum (the same as that of pregnancy) in the absence of a normally developing foetus in the uterus. In the past the condition has frequently been described as a cause of the absence of heat in non-pregnant animals. In all those cases examined by the author post mortem, the condition has been accompanied by abnormality of the uterus—cystic hypertrophy of the endometrium, pyometra, or the presence of a mummified foetus. The first point to be discussed is—how may a persistent corpus luteum be recognized? How does it differ from the fully developed corpus luteum in dioestrus? The only visible difference is that in the case of a persistent corpus luteum, the germinal epithelium over its most superficial parts or its protrusion from the surface of the ovary is white and scarred, and that the protrusion itself is much less distinct and prominent than it is in the case of a recently developed corpus luteum. In addition it presents the same difficulties to enucleation by squeezing as does that of pregnancy.

It is probable that in all cases the initiation of persistency was pregnancy, but that, for some reason or other, the embryo perished. The hypothesis is advanced that under the influence of a persisting corpus luteum, the endometrium undergoes hypertrophy which makes it a favourable focus for invasion by pyogenic organisms which reach it from endogenous sources with the result that pyometra develops.

It is significant in cases of pyometra in which the cervix is sealed that the administration of stilbæstrol, which causes regression of the corpus luteum, is followed by liquefaction of the cervical seal and expulsion of the uterine contents. Many cases so treated make a complete recovery.

The author has noticed among his post-mortem specimens of pyometra, the abnormal frequency with which twin and even triplet corpora lutea are present in the ovaries and he assumes therefrom that death of the embryos is more likely to occur after multiple than after single ovulations. It is significant also that in *T. fetus* infection, a condition in which early death of the embryo is common, the incidence of pyometra is relatively high.

There is evidence that the administration of luteinizing hormone in the treatment of ovulatory failure may provoke the formation of persistent corpora lutea with cystic changes in the endometrium (Wright, 1948).

FREQUENT RETURN TO SERVICE

By this is meant that an animal showing regular heat cycles fails repeatedly to conceive to matings by known fertile bulls. Cases may

regarded as pathological. Anæstrus is also common in cows which are debilitated from any cause. It seems probable that perfect sexual function is dependent on a high nutritional level and when debility exists either from dietetic factors or disease, reproduction will suffer. In heifers, a combination of a poor diet and parasitism is a common cause of anæstrus.

Pregnant mare's serum in doses of 1500-3000 units, by intramuscular injection, has been spoken of highly in the treatment of the condition (Bhattacharya, Hammond, and Day, 1941). In the author's hands it has been singularly ineffective. It has certainly provoked changes in the ovaries but these have been in the nature of super-follicle development without ovulation or the formation of a corpus luteum, and in most cases heat has not developed.

In the majority the condition resolves spontaneously when the animals are turned out to grass in the early summer. Treatment must aim primarily at improving the animal's condition by giving an adequate balanced diet and dealing with any disease factors which may co-exist.

"Cystic Ovaries"

This condition is encountered chiefly in cows but occasionally in unbred heifers. Examination reveals one or both ovaries to be abnormally large. The impression imparted to the fingers is that they contain several cysts up to 2.5 cm. in diameter. Repeated examinations over a period of several months reveal no change. The condition is most common in the winter months. Squeezing of the ovaries may cause a cyst to rupture but this does not provoke heat or any appreciable change in the condition. More often they are resistant to pressure. Stilbæstrol and pregnant mare's serum have been used in its treatment without avail, but the animals may recover spontaneously when they are turned out in the summer. It is possible that in those cases of cystic ovaries in which absence of heat is a feature that there is active lutein tissue in one of the cysts. Such has been found on post-mortem examination.

In the majority of cases the condition has not been associated with endometrial changes and after a variable delay normal ovarian function has been re-established and conception occurred. One, however, has been met in which cystic ovaries with luteinization, was accompanied by endometrial hyperplasia and pyometra.

The use of luteinizing hormone in the treatment of ovulatory failure is discussed later.

Luteinization of the Follicle without Ovulation

Frequently on post-mortem examination one of the ovaries is found to be a little larger than can be accounted for by the normal changes which occur during the cycle, and palpation indicates that it contains fluid. The surface shows no protrusion of lutein tissue nor the minute depression which indicates the point of ovulation. Section reveals a single, large follicle, about 3 cm. in diameter, the wall of which is partially or completely lined by a layer of luteinized cells about 0.2 cm. in thickness. The condition differs from that referred to as cystic ovaries

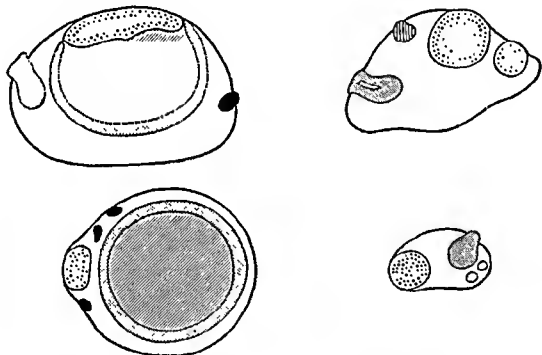


FIG. 231.—LUTEINIZATION OF THE FOLLICLE WITHOUT OVULATION.

with luteinization, in that there is a single large follicle only and lutein tissue is more abundant (Fig. 231). Moreover, there is often evidence that the animal has been having recurrent cycles for the regressing remnants of previous corpora lutea are evident. It is improbable that the condition will be diagnosed accurately by rectal examination.

In the past this ovarian abnormality has been called "cystic corpus luteum," but in this connection a word of warning is necessary. We have learned that the normal corpus luteum of dioestrus frequently possesses a central, fluid-filled lacuna, but in these there is the normal protrusion from the surface of the ovary and in its centre the ovulation point can be seen. When such corpora lutea are followed by pregnancy, the cavity becomes filled by white collagen fibres.

primarily be divided into those in which no abnormality is detected and those in which, either during life or post mortem, a lesion or lesions are discovered.

No Abnormality Detected

There are still many factors associated with infertility which are not understood. It is probable that many accidents can occur during the early life of the fertilized ovum or the embryo; accidents hardly accountable under the accepted conception of pathology, whereby development is interrupted and the reproductive process fails. Under the best conditions of animal husbandry there are always infertile matings. Frequently it is found that a cow fails to conceive to two, three or even more services by a fertile bull, yet ultimately does so without treatment or interference whatever. There has been a tendency in the past to regard failure to breed as synonymous with failure of fertilization, but it is probable that in many such cases fertilization occurred but the embryo subsequently perished. Of recent years it has become the custom to subject such animals to *uterine irrigation* in the belief that a mild degree of metritis is the cause but there is very little satisfactory evidence to support this. In other cases it is suggested that failure of the cervical mucus properly to liquefy at oestrus may cause blockage of the cervical canal, but here again real evidence is lacking.

In ordinary commercial herds cows which are not pregnant after three or four matings may have ceased to be a sound economical proposition and they are discarded at the end of their lactation as sterile.

Abnormalities Detected

Delay in Ovulation

This is regarded by many to be a significant factor in bovine sterility, but most of the evidence is based on the findings of rectal examination. Unfortunately this is not entirely acceptable, for palpation of the ovaries, particularly in multigravid cows, does not afford irrefutable evidence of ovulation. Nevertheless, cases have been seen in the Liverpool Field Station clinic at post-mortem examination in which ovulation had not occurred up to 76 hours after the animals had been observed to be in heat.

It is advised when dealing with apparently normal animals which do not conceive readily to re-introduce them to the bull 24 hours after the first service and if they "stand" allow a second mating. This may be augmented by the introduction of semen directly into the uterus by artificial insemination on the day following the end of the acceptance period.

Examination: Cow in good, fat condition. "Dry." Upward rotation of the posterior end of the sacrum marked. Relaxation of the sacro-sciatic ligaments and falling-in of the quarters. Excessive development of the neck and shoulders. Inclined to attack when approached.

Rectal examination: Uterine cornua 1 inch in diameter; tense. Right ovary spherical in shape, about $1\frac{1}{2}$ inches in diameter; fluid wave of several large follicles detected. Left ovary small and significant.

The right ovary was removed by vaginal ovariectomy. It contained three dense-walled cystic follicles of 2.0 cm. The left ovary was palpated during operation and the rectal findings confirmed—no active corpus luteum nor appreciable follicles. No change occurred in the animal's disposition or appearance and four months later she was destroyed.



FIG. 232.—5-YEAR-OLD RED POLL COW—NYMPHOMANIA.

Post-mortem findings: Uterus normal. Swabs taken from the uterine cornua, cervix, left ovary and right ovary showed no pathogenic bacteria. The left ovary had become cystic. It contained three dense-walled cysts of 2.0–2.4 cm. There was no sign of lutein. Since operation the right oviduct had become strangulated by scar tissue and was cystic.

(2) $5\frac{1}{2}$ -year-old Friesian.

Calvings: First —November 29th, 1945.

Second—January 14th, 1947.

History: The cow failed to breed to numerous services after the second calving. Towards the end of her lactation nymphomania developed and later her behaviour to other cows became bull-like. At this time displacement of the sacrum was noticed as also was a vocal change.

May 18th, 1948. *Rectal examination:* Right ovary abnormally but not grossly enlarged. Estimated size $1\frac{1}{2}$ inches by $1\frac{1}{2}$ inches. Condition diagnosed as a multicystic ovary. Left ovary small, flattened from side to side and considered to be inactive.

Cystic Ovaries with Nymphomania

Nymphomania associated with cystic changes in the ovaries sometimes occurs naturally in cattle. (The condition can readily be induced by the administration of oestrogenic hormones.) The affected animal has generally bred several calves and the history is that following the last calving, oestrus became irregular and the animal failed to conceive. Later heat became continuous. As the condition develops it is noticed that she will mount other cows whenever opportunity offers and allow others to mount her. Milk yield falls and soon ceases. She may bellow a great deal; the voice tending to become male-like in character. Soon, noticeable changes occur about the pelvis. The sacro-sciatic ligaments relax and the sacrum becomes displaced, its caudal extremity becoming elevated. (Similar, but less pronounced changes have been seen in cases of cystic ovaries with absence of heat.) Relaxation of the sacro-iliac interosseous ligaments may cause a wobbling gait. The hind-quarters become bull-like in appearance and the musculature of the neck and shoulders may become abnormally well developed. In cases of nymphomania provoked by the subcutaneous implantation of stilbæstrol with the object of inducing lactation, it has been noticed that a high proportion of animals so treated sustain fracture of the ilium as the result of a fall; generally when mounting another cow. Whether this is due solely to the fact that the nymphomaniac animal, by her behaviour exposes herself to injury more frequently, or whether some change in the structure of the pelvic bones renders them more fragile, has not been determined. Similar fracture of the pelvis has been seen to follow naturally developed nymphomania.

The ovaries are cystic; generally one or both contain three or four cysts 2.5-3.0 cm. in diameter. (On rectal examination the ovaries feel similar to those described as cystic ovaries with absence of heat.) Occasionally an ovary may contain masses of cysts and attain the size of a cocoanut. No evidence of active lutein tissue is found.

The two following case records serve to illustrate clinical features of the condition:

(1) 5-year-old Red Poll Cow (Fig. 232).

History: Has had two calves, the last 15 months ago. Parturition normal. After her about. Has developed a masculine appearance—very high at the base of the tail with a hollow on each side. Prior to being sent for treatment the cow was made to do draught work.

and guarded needles have been designed for rupture of ovarian cysts through the rectal or vaginal walls.

The author's experience has been that the rupture of cysts is not followed by a restoration of normal ovarian function; the cysts have recurred. From the cases cited on pp. 406-8 it will be noted that even when a unilateral cystic ovary has been removed surgically, the remaining ovary quickly became cystic also.

The rational method of treatment would appear to lie in the administration of the deficient anterior pituitary hormone. Kock recorded encouraging results in the treatment of nymphomania by the injection of Prolan "A" in oil. Hancock (1947, 1948) has reported on the use of luteinizing hormone in cases of cystic ovaries both with and without nymphomania. Of 33 cases treated, ovulation followed in 30 and of these 19 (57 per cent.) became pregnant. He points out that such treatment may be associated with superovulation. In the author's single experience of luteinizing hormone in the treatment of nymphomania (p. 408) twin ovulation occurred and the corpora lutea which developed persisted until the animal was destroyed 3 months later.

Ovaro-bursal Adhesions

Williams (1939) drew attention to this condition as a cause of infertility in cattle and Rowson (1942) reported on its relatively common occurrence in England.

The post-mortem examination of bovine ovaries frequently reveals the presence of strands of adventitious tissue on their surface and on section it can generally be seen that these strands are adherent to the scars of old corpora lutea. This is probably the precursor of the condition ovaro-bursal adhesions.

In the simplest cases these adhesions comprise one or several adventitious "strings" between the ovary and the fimbria or the inner bursal wall. Sometimes a band-like connection is seen. In more advanced cases the fimbria is firmly adherent to the ovary and the "mouth" of the bursa may be completely obscured although its cavity remains patent. In more advanced cases still, the bursal wall is fibrosed and shrunken, and finally the bursa is entirely obliterated and its wall everywhere adherent to the meso-ovarium and the ovary. In the last two types, localized or diffuse distensions of the oviduct are often seen (hydrosalpinx, cystic oviduct). Occasionally such an oviduct is the focus of pyogenic infection (pyosalpinx).

In mild cases the affected ovary functions normally and developing

May 10th, 1948. *Ovariectomy*: Right ovary removed by the vaginal route.

There was no evidence of luteal tissue either active or degenerative.

The left ovary was palpated at time of operation and previous estimation of its condition confirmed.

each of 1500 units. The first by intravenous injection and the second and third by intramuscular injection.

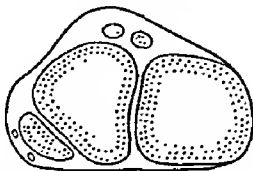


FIG. 233.—RIGHT OVARY (CYSTIC), REMOVED BY OPERATION.

As the result of this treatment the ovary underwent a definite change. At first it enlarged still further. Then it became smaller and harder. Two projections developed on the surface and it became larger again. Finally the projections receded and while remaining larger than it had been originally, the ovary became hard. It remained in this state until the animal was destroyed three months later.

At no time had any evidence of oestrus been seen. Vaginal mucus had been carefully watched but nothing approaching the copious, transparent mucus of oestrus had been seen.

The animal's bull-like behaviour towards other cows was unchanged. The left ovary as seen at post-mortem examination is seen in Fig. 234.

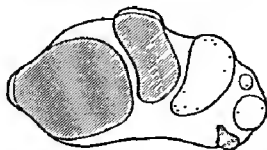


FIG. 234.—LEFT OVARY. TWO PERSISTENT CORPORA LUTEA.

Treatment of Cystic Ovaries. Rupture of the cysts by pressure has long been the accepted treatment. It is most often performed per rectum. There is great variation in the density of the cyst wall and while some may burst quite readily on the application of reasonable pressure others resist even the most vigorous squeezing. It is suggested that those cases which defy pressure per rectum be treated through the vaginal wall, tail w. to do it is possible safely to apply greater force. Fine guarded bistouries

and guarded needles have been designed for rupture of ovarian cysts through the rectal or vaginal walls.

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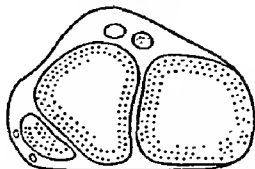


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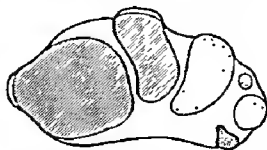


FIG. 234.—LEFT OVARY. TWO PERSISTENT CORPORA LUTEA.

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certain strain of subterranean clover which is believed to contain large quantities of oestrogenic factors. Cattle and horses bred and maintained on the same farms have shown no corresponding problem.

The disease has three principal manifestations :

(1) *Infertility in Ewes*. The animals fail to breed to repeated service by known fertile males. Post mortem a cystic glandular hyperplasia of the endometrium is found.

(2) *Dystocia*. A maternal dystocia which results from inertia of the uterus and is characterized typically by lack of external signs of imminent parturition and by death of the full-term foetus. In some instances lambs are born dead, but more commonly the foetus is not delivered and may be dead for some days before presentation occurs.

(3) *Prolapse of the Uterus*. This generally occurs some months after lambing and may even be seen in young unbred animals.

Rams maintained on the clover show no abnormalities, but wethers and unbred ewes often show udder development with milk secretion. The wether may also develop metaplasia of some of the accessory sex organs.

With the development of this form of clover feeding the lambing percentage has fallen during 5 years to as low as eight. The highest dystocia incidence recorded was 40 per cent. and that of prolapse 10 per cent.

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follicles and a functioning corpus luteum are seen. In cases in which adhesions are more extensive, luteinization within a follicle is noticed. In gross cases the affected ovary is generally functionless.

Adhesions, generally of a gross character, are frequently found associated with tuberculous peritonitis and salpingitis, but many cases occur in which no macroscopic evidence of that disease is seen; in fact, no active inflammatory changes are evident. Moreover, the condition is well recognized in America, where the incidence of bovine tuberculosis is very low. The author has also seen the condition in cases of peritoneal adhesions associated with peritoneal abscesses, some of which had their origin in traumatic reticulo-peritonitis.

Williams has suggested that frequent expression of the corpus luteum and other vigorous ovarian manipulations are a cause.

Other hypotheses as to the cause are *Br. abortus* infection and retention of the foetal membranes. Ovaro-bursal adhesions are a feature of the specific vaginitis of cattle in East Africa (p. 414).

The condition is most common in multigravida but it has been observed in heifers. Theoretically, provided a case is slight only, fertility would not be impaired. Moreover, in advanced but unilateral cases, fertility while reduced should not be completely lost; in fact cases of pregnancy with advanced unilateral adhesions have been seen post partum (such adhesions, of course, may have been acquired subsequent to conception). Nevertheless, cases of prolonged infertility have been encountered in which unilateral adhesions were the only abnormality found post mortem.

Diagnosis in life is difficult and may be impossible. In early cases the degree of change is quite insufficient for detection by rectal palpation. In advanced cases may be strongly suspected owing to irregularity of outline and lack of movability of an ovary, but even in these errors will be made. The delicate bursal wall is not a structure which can with certainty be picked up with the fingers, while palpation of the normal oviduct is most uncertain and when it is felt in the fingers it is more by accident than design.

Infertility in Sheep Fed on Subterranean Clover

Attention must be drawn to the condition which has recently been recorded in Australia by Bennetts and his co-workers (1946) for it throws a new light on reproductive disorders in ruminants. The disease they describe is of a much grosser nature than anything encountered in this country. The sheep involved are fed almost exclusively on a

Quinlan (1927) has put the disease as causing 18 per cent. of the sterility in cattle in South Africa, and the author believes it will be found responsible for a no less percentage in infected herds in this country. Steward (1941) in the examination of 79 random specimens of uterine discharge found 30 per cent. to be positive for tubercle bacilli.

The Uterus. Williams has classified uterine tuberculosis as being of three clinical types—peritoneal, glandular and epithelial.

1. *Peritoneal*. The outstanding feature is extensive adhesions of the cornua to themselves, the parietal peritoneum and adjacent organs. The adhesions often contain multiple abscesses up to the size of a hen's egg or even larger.

2. *Glandular*. This type involves chiefly the glandular layer of the mucous membrane and is characterized by marked hypertrophy of a diffuse or nodular nature. Caseous or caseo-purulent foci of variable size are found throughout.

No clear line of demarcation exists between these types, but one generally predominates. The condition is generally bi-cornual and to a degree symmetrical. The presence of a vulval discharge varies, depending on the degree to which the mucous membrane is involved. In advanced cases there is a profuse muco-purulent discharge, pyogenic infection being added to the tuberculous one. In these cases the oviducts are almost invariably involved.

3. *Epithelial*. This type is generally blood-stream in origin and the lesions take the form of multiple pin-head-sized granulomata. Often there is no appreciable enlargement of the uterus, but a vulval discharge, from which acid-fast organisms can readily be isolated, is the rule. The discharge may be sero-sanguinous or frankly purulent.

Tuberculosis of the uterus is not an inevitable barrier to reproduction, for quite frequently a calf is born from a grossly infected uterus (the calf itself being affected by the congenital form of the disease), but it is probable in such cases that the uterine infection was acquired or, at least, rapidly developed during pregnancy. The epithelial form is especially liable to develop after parturition.

The oviducts are generally involved in types 1 and 2. They become progressively thickened, often attaining a diameter of 1 cm., and may contain local abscesses. There are generally adhesions of the bursa to the ovary. An ovary itself may be the site of tuberculous abscesses. The cervix is rarely affected.

The diagnosis by rectal examination of early cases may be difficult, but particular attention should be paid to the oviducts, for the detection

CHAPTER 37

INFECTIONS OF THE GENITAL ORGANS OF THE COW

Puerperal Metritis

It is reasonable to assume that during the puerperium the endometrium affords a favourable medium for the multiplication of bacteria; in fact, it is probable that a mild degree of metritis develops during this period. Bosworth (1941), working with the author, found that swabs taken from the uterine cervix during the puerperium of heifers which had calved normally showed *C. pyogenes* on culture, but when uterine involution was complete such swabs became sterile. The heifers subsequently conceived without abnormal delay. But the uninjured endometrium possesses amazing powers of resolution and by the time involution is complete, in the course of 14–21 days, such infection is overcome naturally. Any factor which delays the onset of or the course of involution will tend to favour and prolong such infection. Protracted labour or retention of the foetal membranes are such factors, but even in these recovery occurs. It must be recognized, of course, that puerperal metritis can be a serious matter; it may, in fact, cause the death of the cow. Protracted dystocia with death of the foetus, the onset of putrefactive emphysema and exhaustion of the uterus, and possibly injury during forced delivery may quickly be followed by death from toxæmia and septicæmia. If such an animal survives, chronic metritis with sterility may supervene. Moreover, the animal in her weakened state may become anæstrous. Such cases, however, are the exception and not the rule, and it may be taken that infections acquired at parturition are not a common cause of prolonged infertility.

The treatment recommended for puerperal metritis is that described on page 368.

Tuberculosis

In herds in which the incidence of this disease is high, tuberculosis of the genital organs is not an uncommon cause of sterility. Infection may attain the tract either by spread from the peritoneum via the oviducts or by penetration of the serosa, or by blood-stream invasion, in which case the endometrium may be involved in the absence of serous or tubal lesions.

It comprises mucin and polymorphonuclear leucocytes. Vulval discharge soils the tail and is carried by it on to the hairs of the buttocks where it dries forming flakes like shellac. Speculum examination shows diffuse congestion of the mucus membrane of the anterior vagina and sometimes of the folds of the external cervical protrusion. There are no ulcers, vesicles or granular lesions.

Infective exudate is bacteriologically sterile and contains no protozoa. As yet transmission experiments using filtrates of exudate have been unsuccessful but the large quantities of mucin present make efficient filtration difficult.

Field experience indicates that the disease is transmitted by coitus only but unless care is taken it may readily be spread by the use of a speculum.

During the stage of active infection in the female, which may last 2-3 weeks or up to six months, œstrus is normal or almost so. Occasionally one or two periods may be missed. Service during the active stage is seldom followed by conception and clinical evidence suggests that mating during the active stage tends to prolong the infection.

In improved herds the majority of cows and heifers recover naturally but in from 15-25 per cent. of cases sterility ensues consequent on lesions in the oviducts. Local blockage of one or both tubes may result in diffuse distension by normal secretion or to a series of localized distensions. Quite often an ovary is found to be enclosed in a cyst which may be as large as a golf-ball. This is due to adhesion of the fimbria to the ovary and cyst formation in the pavilion of the oviduct. In addition to these local changes, there usually occurs a dry, adhesive peritonitis. Adhesions are frequently present in the pelvis and they may occur elsewhere in the abdominal cavity, particularly between the liver and diaphragm.

The ideal method of control is the replacement of natural service in infected herds by artificial insemination.

In the bull, active infection of the penis and sheath has not been conclusively demonstrated and the characteristic lesion is enlargement and hardening of the epididymis. This is usually bilateral. While the whole of the epididymis is affected the more advanced changes occur in the "tail" which may come to resemble a billiard ball in size and hardness. Clinical experience suggests that in some natural cases there is a sudden, diffuse enlargement of the testicles and that when this subsides the swollen epididymes can be detected. This diffuse orchitis has not been produced experimentally.

During the early stages of infection sexual appetite is unimpaired although fertility is reduced even before clinical changes are evident. Eventually sexual desire is lost.

of thickened, tortuous tubes is diagnostic. (In this connection care must be taken that the terminations of the cornua are not confused with the oviducts.) In advanced cases, diffuse or nodular enlargement of the uterus will be readily detected. In infected herds, an animal showing a chronic vulval discharge continuing beyond the puerperium should always be examined for acid-fast organisms, and premature births should be regarded with suspicion.

Brucellosis

Br. abortus has a predilection for the gravid uterus, in which it multiplies, setting up a placentitis which often results in premature expulsion of the foetus, thus causing serious losses in calf production and milk yield. Abortion generally occurs during the period 4-7 months of gestation, although infection may exist in cows which calve at term. In the majority of cases abortion occurs once only, and if they subsequently conceive infected animals carry to term, but in a minority a second and even third abortion may follow a single infection. In itself the organism causes no permanent change in the uterus and the organ clears itself of the bacillus within a few weeks of expulsion of the foetus. It is generally believed that infection delays involution and favours retention of the foetal membranes and secondary puerperal infection. The part, if any, played by *Br. abortus* in the causation of infertility associated with ovarian dysfunction and ovaro-bursal adhesions is not known. The view that its importance has been exaggerated in the past is gaining wider acceptance.

Specific Venereal Bovine Epididymitis and Vaginitis

This is a specific disease of cattle confined, as far as is known, to East and Central Africa, which is transmitted by coitus and is characterized by a muco-purulent vaginal discharge in females and in some cases permanent lesions in the fallopian tubes, and by hardening and swelling of the epididymis in the male. The disease is of low pathogenicity for the indigenous zebu cattle but causes serious infertility in improved British cross-breeds. The condition has been studied by Anderson (1937), Daubney, Hudson and Anderson (1938) and Hudson (1949) and it is from the writings of these workers that the following description has been obtained.

During the active stage of infection in cows and heifers there is present in the vagina a fairly copious, odourless, mucoid exudate resembling egg-white in consistency but opaque and yellow in colour.

the organism may be harboured for long periods without showing any abnormalities of the genital organs and during this period it transmits infection at service. Owing to the unreliability of the blood serum agglutination test for the diagnosis of *V. fetus* infection, tests were carried out using vaginal mucus (after the manner described by Pierce for *T. fetus* agglutinins) with the results given in Table 14.

In 1949 also, Lawson reported his strong suspicion that *V. fetus* infection played a significant part in the incidence of bovine infertility in this country.

Pleuropneumonia-like Organisms in the Genital Tract

The finding of organisms of the pleuropneumonia type in the genital tract of human beings has recently aroused interest and Edward, Hancock and Hignett (1947) in this country have reported an investigation into the presence of these organisms in cases of bovine infertility which seem to be of an infective nature but which cannot be ascribed to any known pathogenic organisms. The examination of vaginal mucus from 64 cows and of semen or seminal vesicle secretion from seven bulls revealed pleuropneumonia-like organisms to be present in 18 of the cows and six of the bulls. Nielsen (1948) in Denmark reports the isolation of similar organisms from the uterus of sterile cows and from the semen of a bull.

Edward *et al.* stress that it is not yet possible to assess the significance of these organisms in the bovine genital tract, pointing out that in the human subject while such organisms have only been isolated from cases of urethritis in the male, they have been recovered from apparently healthy females.

Trichomoniasis

The recognition of *Trichomonas fetus* infection (Riedmuller, 1928; Abelcin, 1932; and others) as a cause of infertility in cattle was a milestone in our knowledge and since the first report of its existence in this country (Stableforth, Scorgie and Gould, 1937) many outbreaks have come to light. Since that time Kerr and his co-workers in this country and Bartlett and his colleagues in America have been prominent students of the disease.

The causal organism is a flagellate protozoan. In the female infection is characterized by a low conception rate, a profuse muco-flocculent vulval discharge, early abortion and pyometra. Irregularities of the

In advanced cases the testicles become fixed in the scrotum by adhesions between the epididymis and the adjacent parts of the testicle and the vaginal sac. Rectal palpation often reveals that the seminal vesicles are enlarged and indurated.

Vibrio Fetus Infection

Although *Vibrio fetus* infection (McFadyean and Stockman, 1911) has long been recognized as a cause of abortion both in sheep and cattle, it is generally believed that the extent of the infection in animals in this country is very limited and as a possible cause of infertility in cattle it has received little or no attention. McEwen (1940) reported that the bacteriological examination of 247 bovine aborted fetuses showed that only five were infected with *V. fetus* and evidence obtained from the three herds in which the infection was diagnosed indicated that in no instance could the organism have been responsible for a high incidence of abortion.

In 1949, however, Sjollesma, Stegenga and Terpstra reported a form of enzootic sterility in cattle in Holland which they believed to be caused by *V. fetus* and transmitted by coitus in the semen. The condition may also be transmitted by artificial insemination. They report a very low conception rate from infected service and the development of a catarrhal condition of the cervix and uterus. The organism has been isolated from vaginal exudate and from the semen of incriminated bulls. They point out that the condition bears clinical similarities to the disease described by Webster (1932) in Australia and ascribed by him to a streptococcus, with the exception that in the disease in Holland there is no reduction in the quality of the semen of infected bulls. They concluded that in the female the infection is temporary only and that immunity is established in about three months. In the bull, however,

TABLE 14

Enzootic Sterility in Holland. Results of Agglutination tests for *Vibrio fetus* using vaginal mucus. (Sjollesma, Stegenga and Terpstra—1949)

Mucus samples	Cows served by a bull infected with or suspected of enzootic sterility	Cows served by a bull not suspected of enzootic sterility	Cows not previously served or not served after last parturition
Number	54	13	12
Positive agglutination with <i>V. fetus</i> antigen	38 (70 per cent.)	0	0
Negative results	16	13	12

according to the activity of the infection. Initial infections generally terminate pregnancy almost from the outset and they are followed by a variable degree of uterine involvement. Less active infections, influenced in measure by resistance acquired from previous infections, may not prevent pregnancy proceeding to a more advanced stage and the abortion of visible fœtuses or the development of pyometra more often follows repeated than primary infection. Nevertheless both initial and reinfection are occasionally followed by normal pregnancy.

Visible abortion generally occurs at the 2-4 months' stage and it is significant that in those cases which expel the fœtus at the later limit, its size is smaller than that appropriate to the period of gestation. (A fœtus of 6-7 cm. bodylength is often expelled at 100-120 days, by which time it should be three times that size.) This discrepancy has been described as a slowing down in the rate of development of the fœtus. The author suggests it is more likely that fœtal death occurred at the time appropriate to its size—about the 9th week, and that there was a delay before the corpus luteum underwent the regression necessary for its expulsion. In such abortion cases the fœtus which is grey in colour is generally expelled complete in its membranes. There are no signs of putrefaction, and *T. fœtus* can readily be demonstrated in the fœtal fluids. After the act of abortion, however, parasites quickly disappear from the vaginal discharges and it is unlikely they will be found later than 7 days after the act. The author has had an animal conceive normally to artificial insemination using clean semen 67 days after abortion.

It is probable that those cases which develop pyometra were originally pregnant and that it was pregnancy which initiated the persistence of the corpus luteum which is a consistent feature of the closed pyometra, which complicates *T. fœtus* infection. In fact, if regression of that structure is provoked by the administration of an œstrogenic substance such as stilbœstrol, the uterus will empty itself and recovery may occur. The pus in these cases is teeming with trichomonads in association with pyogenic corynebacteria.

There appears to be great variation in the intensity and duration of infection in individual females. In some no clinical signs of infection are seen after exposure, yet their subsequent conception to the use of carrier semen indicates they have a tolerance. Whereas in those in which an œdematous condition of the uterus develops, the parasite may be found for as long as 4 months after infected service, while in cases which ultimately abort or develop pyometra the parasite continues to flourish in

œstrous cycle are common in infected herds, but as this condition is frequent also in non-infected ones, too great stress should not be laid upon it.

Cows and heifers exposed to infected service fall into the following clinical groups:

- (a) Conceive and carry to term without clinical signs of infection developing.
- (b) Return to multiple services, but show no obvious signs of infection. Œstrous periods may be regular or irregular.
- (c) Fail to conceive and develop an œdematous condition of the endometrium with a muco-flocculent discharge.
- (d) Conceive but abort at from 2 to 4 months of gestation.
- (e) Develop pyometra with anœstrus.

The clinical picture is well illustrated by a herd attended by the staff of the Liverpool School (Wright and Arthur, 1945). The disease had been introduced by a bull 10 months prior to the commencement of the investigation, by which time 77 cows and heifers had been exposed to infection by one or more services.

21 per cent. conceived and carried to term and no evidence of infection was found.

49 per cent. failed to conceive but the parasite was not isolated from them.

30 per cent. showed the presence of the parasite. This group comprised

23 animals; 4 of them aborted and 4 others developed pyometra.

The pathology of the disease is imperfectly understood. Kerr (1944) has described a condition of œdema of the endometrium which he ascribes to an allergic response. Such cases are frequently met in the field. Affected animals show an intermittent vulval discharge and on rectal palpation the uterus is found to be enlarged and flaccid. Manipulation of the uterus often provokes a discharge from the vulva and motile trichomonads can generally be demonstrated in it. Kerr and Robertson (1941, 1943) have shown that both naturally and artificially infected cows develop specific agglutinins against the parasite in their blood serum, while Pierce (1946) has found that similar agglutinins develop in the vaginal discharge of infected animals. There is evidence that animals which develop a clinical infection may subsequently conceive to infected service and carry to term, but it would appear that immunity is lost after a normal gestational period. In the female the disease is essentially self-limiting and infection confers a relative degree of temporary resistance. The effects of *T. fetus* on conception varies

The author has never found persistence of infection throughout a normal pregnancy and this is confirmed by the experience of Bartlett and his co-workers in America. It may thus be taken that any animal which has carried to term subsequent to infection is free from the disease.

Diagnosis. A positive diagnosis of the disease can only be made on the detection under the microscope of the living organisms in the mucus obtained from the vagina. Suspicion of its existence is aroused by the failure of a high proportion of the cows and heifers to conceive to a bull whose semen is found to be normal both as regards the number and motility of spermatozoa. Suspicion is increased by the development by some of the females of a profuse muco-flocculent vulval discharge. (In this connection it should be stated that since recognition of this infection, farmers have become acutely "discharge" conscious, and the normal discharge which follows the œstrous period has frequently been confused with that of *T. fetus* infection.) The abortion by several animals of fetuses about 6 cm. long, 2-4 months after service is almost conclusive evidence of the existence of the disease.

When investigating infertility in a herd its possible presence must always be in mind. The parasite is most likely to be demonstrated in cases of œdema of the uterus, recent abortion, pyometra and infected animals which are just coming into heat at the time of examination. It is best to examine fresh material at the farm, but motility of the parasite is maintained for several hours (or even days) if the specimen is kept warm. Material contaminated by feces should not be used for motile bacteria may be confused with the parasite. Mucus from the vagina may be obtained with the hand or with a speculum. If the hand is used it should be lubricated with soft paraffin and not soap and water as the latter kills the parasite. Bartlett uses a pipette (Fig. 236) for obtaining mucus for examination. In doubtful cases, detection of the parasite may be facilitated in the laboratory by incubating the mucus in an enrichment medium.

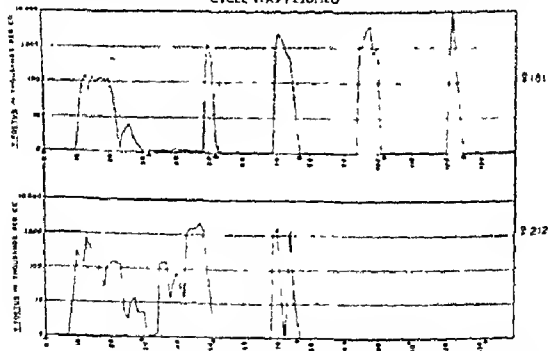
A little mucus is placed on a slide and covered by a cover slip. (Owing to its viscosity, the mucus is difficult to manipulate and it is easiest to snip off a little with scissors for placing on the slide.) Examination under the $\frac{1}{6}$ th objective shows the flocculent material to be a mass of leucocytes in which the motile parasites can be seen. The degree of motility varies; in the majority the parasite makes recognizable movement about the field, but in others rapid wave-like movement of the dorsal membrane only can be seen. Stained specimens are not easy of detection.

It should be reiterated that in pyometra cases there is frequently a

the uterus as long as the uterus is occupied by fetus or pus, but once it is evacuated the organism quickly disappears.

There is considerable variation in the times after infected service at which trichomonads can first be demonstrated in the vaginal mucus; the frequency with which they can subsequently be found and the period of time during which they persist. Pierce (1946, 1947) records cases in which trichomonads were first found 9, 12, 15, 27 and 29 days respectively after infection in heifers, after which they were found irregularly for varying periods of up to 56-132 days. He also noted their presence in greater numbers and their greater motility in the copious mucus of the uterine type than in the more scanty and sticky vaginal type. Bartlett (1947) has reported similar findings (Fig. 235).

OCCURRENCE IN VAGINAL SAMPLES WHEN RETURN TO OESTRUS WAS EARLY AND OESTROUS CYCLE WAS RESUMED



OCCURRENCE IN VAGINAL SAMPLES DURING PYOMETRA + OESTRUS

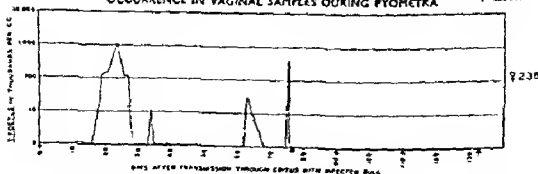


FIG. 235.—THE PERIODIC OCCURRENCE AFTER INFECTION OF *Trichomonas fetus* IN THE VAGINAL MUCUS OF CATTLE.
(Bartlett, D. E.)

defined the word pyometra to describe those cases in which the cervix is closed and in which there is a gross accumulation of pea-soup-like pus in the uterus.)

(b) *Intradermal "Tricin" Test.* "Tricin," an antigen prepared from cultures of *T. fetus* and analogous with tuberculin, is injected intradermally into the neck in a dose of 0.1 c.c. A positive reaction comprises the development of a weal or plaque which attains its maximum size in about 20 minutes and persists for an hour. There is an increase in the skin fold measurement of 2 mm. plus, but the appearance of the weal is said to be a better guide than measurement. Individual reactions vary and the test should be regarded as a herd test rather than an individual one.

(c) *Compliment Fixation.* Mahmood (1944) has shown that the blood of affected animals may show compliment deviation.

These tests are still in their experimental stages and are not as yet sufficiently reliable. The finding of the parasite must be regarded as the only certain evidence of infection.

Treatment and Control. At the commencement of their work on this disease, the author and his colleagues adopted the orthodox treatment of uterine irrigation of exposed animals with solutions of iodine and iodine and lactic acid. In some cases other antiseptics such as mercuric chloride and "Metaphen" were used. Doubts, however, quickly arose as to the value of such treatment, for it was found that infected heifers in which for technical reasons it was impossible to carry out this treatment readily conceived to artificial insemination using clean semen. Moreover, cases were met in which motile trichomonads were found in discharges after irrigation of the uterus and vagina with 0.1 per cent. aqueous solutions of iodine, yet these animals conceived to insemination without further treatment. These facts strengthened the belief that recovery in the female was spontaneous. (The treatment of trichomonas pyometra will receive special consideration under a separate heading, p. 430.) Since that time the treatment adopted by the Liverpool School has been to replace natural service by artificial insemination using the semen of non-infected bulls, and in those cases in which irregularities of the oestrous cycle are a feature, correct them by appropriate treatment. It has been strikingly successful.

When it is established that *T. fetus* infection exists in a herd, the females should be grouped as follows:

(a) Those actually or potentially infected by service from a carrier bull.

discharge of flocculent mucus. It arises from the cervix and vagina and bears no resemblance to the pus which occupies the uterus. Parasites can readily be detected in it.

Kerr and Robertson have devised biological methods of diagnosis.

(a) *Agglutination Test*. Blood serum is used and the test gives better results in the female than in the male. Two distinct strains of *T. fetus* having antigenic specificity have been isolated in the British Isles, strain *Belfast* (Kerr and Robertson) and strain *Moyley*

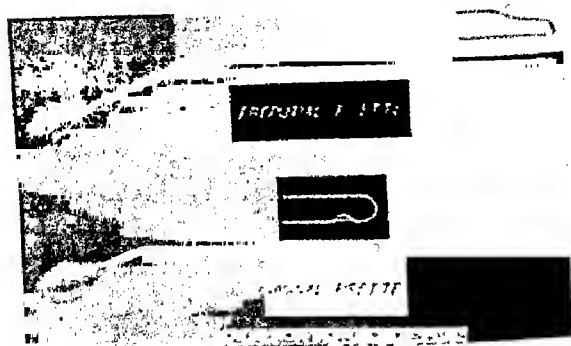


FIG. 236.—PIPETTES FOR THE COLLECTION OF MUCUS FOR EXAMINATION FOR *T. fetus* (Hartley, D. 1.)

Samples from bulls are collected by scraping the surface of the glans penis with the preputial pipette and then flushing the smegma obtained from the pipette into a test-tube of physiological saline solution. No fluid is introduced into the preputial cavity. Samples from females are collected by introducing a vaginal pipette containing 5-7 c.c. of physiological saline into the vagina, compressing the bulb several times to flush the vagina, and then withdrawing the sample and ejecting it into a test-tube.

(Mahmood). There are probably others. Pierce (1949) considers it to be necessary to carry out all agglutination tests in duplicate using both strains and when using the test in a herd suggests that a selection of the animals most likely to react should be made, viz. those with open or closed pyometra or those which have recently aborted as the result of infection.

(A word of explanation is required regarding the term "open pyometra." It is used by many writers to describe the condition referred to in this book as oedema of the uterus. The author has con-

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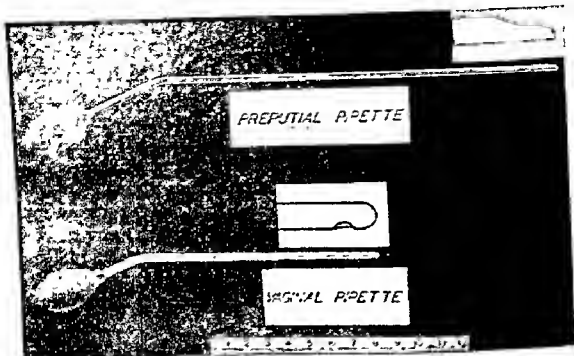


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(b) It is probable that there has already been a considerable loss of breeding time in the herd and efforts to combat it must be instituted immediately.

It will be appreciated that the methods of control previously outlined refer to herds in which the disease is widespread, for clearly, if infection has only recently been introduced and the number of animals exposed is small, it may be more economical to withhold service from exposed females for at least 6 months, or even to destroy them and start afresh. But it will be noted that the word "destroy" is used. On no account must the farmer be advised "to get rid of" infected cows and bulls, for it is probable that they will be sent to market and serve as a source of infection in other herds.

Artificial insemination is a time-consuming practice and, if it is to be carried out by veterinarians only, will greatly increase stock-breeding costs. Thus until artificial insemination centres are developed on a widespread scale, it will be necessary to instruct farmers themselves in the method of carrying out the operation.

T. Fetus Infection in the Bull

self-curing, in the male it is permanent.

Opinions differ as to the pathogenicity of the organism in the male. Swangard (1938) does not believe that *T. fetus* invades the mucous membrane of the urogenital tract and that the parasite occupies only the stratified squamous epithelium of the prepuce. He also states that the flagellate protozoa are not found in the blood of infected bulls.

Kerr (1942) disagrees with these views and cites an experimentally infected bull in which pathological changes occurred not only in the prepuce and on the penis but in the urethra and testes also, and in which the parasite was isolated from the urethra and epididymis at post mortem examination 5 months later. He also quotes a naturally infected bull in which trichomonads were found 18 inches along the urethra.

It is significant that the blood of infected bulls does not respond to the agglutination test.

Views also differ as to whether infected bulls exhibit lesions and symptoms. Kust (1933-1936) states that bulls usually show symptoms early after infection—swelling of the prepuce with some discharge and the presence of small red nodules on the mucosa of the penis. During this period urination may be painful and there is a disinclination to serve. But the disease soon becomes chronic, when symptoms, but for an occasional discharge, are absent.

Kerr (1942) describes a grey, catarrhal condition of the mucosa of the penis with petechiae in the early stages of infection and later the presence of islands of granular tissue comprising inflammatory proliferations of the surface lymphatics, at the base of the penis and at the involution of the preputial sheath. Kerr also stresses lazy service as a feature of infection in the bull.

(b) Those which have not been exposed to infection. This group will comprise recently calved cows not served since, and maiden heifers.

When more than one bull is being used in the herd the general attitude should be that they are all carriers despite the fact that examination of service records indicates that one or other of them has not been exposed to infection. Experience leads to a strong suspicion of the reliability of service records on the average farm and thus the general rule should be that no bull on the farm shall be used to serve clean cows and heifers. This attitude may be relaxed when, for example, a young bull is running with heifers on some remote part of the farm and has made no contact with the general herd. Again, the farmer must be made to understand that it is imperative that there shall be no errors in regard to group (b), and animals about which there is any doubt must be included in (a).

A clean bull must be obtained. It may be decided to use him by artificial insemination only and thus ensure there is no possibility of his being exposed to infection. The practice must be continued until all the adult animals in the herd at the time the infection was demonstrated have conceived and "carried" to insemination. Or it may be decided to allow him to serve naturally animals in group (b) and use his semen for the insemination of those in group (a). Needless to say, the time the infection has been in existence and hence the proportion of animals exposed will influence one in this matter.

In general principle, carrier bulls should be destroyed, but it must be borne in mind that they may be valuable animals of high pedigree whose blood line it is desirable to maintain. As has been previously stated, the author's experience indicates that the semen of carrier bulls when used by artificial insemination on females which have recently been exposed to infection by service may be followed by a high conception rate without evidence of reinfection. As long as the practice is carried out under strict supervision it may be in the farmer's interest to do so. (Treatment of bulls will be referred to later, p. 426.)

It has been officially recommended that for the control of the disease breeding activities should be suspended for 3-4 months, during which time all exposed females are subjected to intra-uterine irrigation, followed by resumption of service using a clean bull.

The author does not subscribe to this recommendation for the following reasons:

(a) There is a risk that the new bull may become infected, for "œdema," pyometra and potential abortion cases may remain infected for months.

Bartlett (1946) has recently carried out tests of the various forms of treatment with acceptable criteria as to cure, with the following results:

1. Three infected bulls received twelve experimental treatments or series of treatments with six active trichomonadocidal agents (sodium hypochlorite, sodium perborate, Lugol's solution, sodium dioctyl sulfo-succinate, sodium ethyl mercuri thiosalicylate, alkyl dimethyl benzyl ammonium chlorides) applied as preputial douches or ointments.

None was cured.

2. One bull was treated unsuccessfully with trypaflavine ointment in accordance with the procedure of Abelein and Swangard.

3. Eight bulls infected with *T. fetus*, two of which were experimentally re-infected subsequent to being cured (a total of ten infections), received twenty-one courses of treatment with potassium iodide orally and/or sodium iodide intravenously. In six instances these treatments were supplemented by preputial douches with an oxidising agent—chloramine T. Six infections were cured and four were not.

He concluded that iodides show considerable value as chemotherapeutic agents in trichomoniasis in bulls and adds that no evidence was found to indicate that the efficacy of iodide treatment was enhanced by concomitant douching of the prepuce with an oxidising agent.

His latest experiments (private communication) indicate the following treatment: sodium iodide in a dosage of 5 g. per 100 lb. bodyweight in 500 c.c. of sterile distilled water, by intravenous injection, on five occasions at intervals of 48 hours.

Pyometra

Pyometra is characterized by a progressive accumulation of pus in the uterus and the persistence of functioning lutein tissue in an ovary. As a rule the persistent corpus luteum is indistinguishable from that of pregnancy and it is thought by many that the condition is initiated by pregnancy, but that the foetus died early in its career and the corpus luteum failed to undergo regression. It is noteworthy that the author has examined a pyometra uterus in which an embryo, 1 cm. long, complete in its membranes, was present. Histological examination of pyometra cases has revealed the glandular parts of the endometrium to be hypertrophied and it is thought that this is the outcome of the hormone influence of the corpus luteum. A case has been seen in which the uterine wall was grossly deformed by numerous glandular cysts varying in size up to that of a cricket ball. It is suggested that such hypertrophy in the absence of a developing foetus renders the endometrium a favourable medium for bacterial invasion. The organisms chiefly concerned are the pyogenic corynebacteria. As a rule affected animals are anæstrous.

It has already been noted that often more than one corpus luteum is present; as many as three have been seen (Fig. 238).

In the majority of cases the cervix is closed; it may in fact be "sealed," and there is no discharge of pus from the vulva, but animals have been

Other observers make no reference to symptoms exhibited by the bull and the clinical history of most natural infections is generally to the effect that the bull has shown no abnormality and that his sexual appetite is normal. In many instances it has been shown that infection causes no change in sperm count and sperm motility.

Diagnosis in the bull is generally based on the finding of trichomonads in the vaginal mucus of cows and heifers served by him only. The isolation of trichomonads from the bull requires a somewhat exact technique and the examination of preputial washings is generally unsatisfactory.

Abelein (1941) recommends the use of a brush passed through a canula into the prepuce for the collection of material for examination. Scrapings from the penial and preputial mucosa with the animal under the influence of epidural anaesthesia are most reliable, but this method is unsuitable as a routine procedure. Bartlett (1947) recommends a preputial pipette (Fig. 236) and stresses that material must be obtained from those parts of the genital membranes in which trichomonads are most likely to be found. (Fig. 237.)

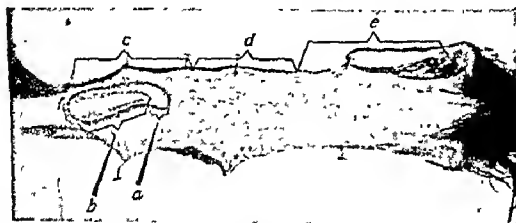


FIG. 237.—THE DISTRIBUTION OF *T. fetus* IN THE PREPUTIAL SAC OF BULLS. (Bartlett, D E)

Average number of parasites per c.c. in scrapings from the designated areas taken at monthly intervals:

Area	Average of 14 scrapings from three infected bulls	
a	..	744
b	..	9529
c	..	1601
d	..	288
e	..	557

Treatment: A moist mixture of ...

rubbed into the mucous membrane of the penis and prepuce on one or more occasions after complete exposure of the organs under epidural anaesthesia.

Many workers have recorded failure, while those who claim to have had success do not do so in every animal. Many ...
maiden heifers.

Histology (G. O. Davies). The endometrium showed changes not unlike that seen in canine "pyometra"; it was considerably thickened and the uterine glands were very numerous, although one could hardly apply the term cystic to the condition, but the evidence in one or two areas was that the condition was approaching that stage.

C. pyogenes was isolated in pure culture from the exudate. In one of the cysts in the ovary there was lutein tissue and the others were lined by granulosa cells. Sections of the right oviduct and of the cervix showed no significant change.

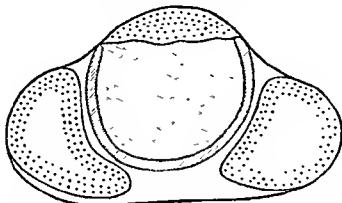


FIG. 239.—OVARIAN CYSTS, ONE OF WHICH IS LUTEINIZED, ASSOCIATED WITH ENDOMETRITIS.

On post-mortem examination the carnucular prominences cannot be recognized. In some there is marked necrosis of the mucosa. There may be pigmentation. The quantity of pus varies greatly, but from the clinical viewpoint the degree of cornual distension is more significant. In the author's specimens such distension has varied from 4.0 to 14.0 cm. It may be symmetrical, but more often that of the cornu on the side of the ovary containing the corpus luteum is the greater. It is striking that cattle suffering from pyometra exhibit little or no general departure from health.

Pyometra associated with *T. fetus* infection presents features different from those previously outlined. Pus is, as a rule, much more copious and may attain a volume of several gallons. It is generally fluid, of a consistency of pea-soup, and its colour greyish-white or white. The uterus undergoes much greater distension. The mucus occupying the cervix is moist and slippery rather than sticky and tenacious, and in it motile trichomonads can generally be demonstrated.

Diagnosis. Early pyometra cases are most likely to be discovered in the course of pregnancy examinations. The animal has been served and there has been no return of heat. The facility with which the condition can be distinguished from pregnancy on rectal examination will depend in large measure on the period which has elapsed since service. At 80-90 days the degree of uterine distension may be similar to that of pregnancy

seen in which there was a pus discharge, and it is of interest to note that in one such case a persistent luteinised cyst was found in the ovary post mortem (Fig. 239).

at time until the animal was normal. There was no recurrence of vulval discharge, milk-chocolate discharge, or any other abnormality. The animal was again pregnant. Uterus flaccid but not appreciably enlarged. Right ovary the size of a hen's egg and cysts could be detected. Left ovary small and of no significance.

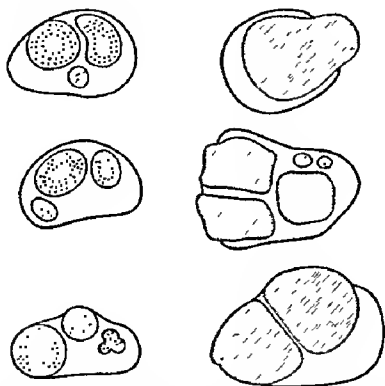


FIG. 238.—THE OVARIES OF PYOMETRA CASES EXAMINED POST MORTEM.

The corpora lutea are of the pregnancy type with scarring of the germinal epithelium over the protrusions.

Post-mortem Examination. March 26, 1945. Breadth of uterine cornua, 6 cm. Uterus occupied by muco-pus, brown in colour. The endometrium of both cornua was thin and pale. There was no evidence of infection. The largest cyst was lined, over the greater part of its wall, by a layer of yellow lutein. The other parts contained no lutein. The left ovary was small and appeared normal.

voked the cervix will relax, the uterine musculature contract and the organ evacuate its contents. Provided the degree of endometrial injury is not such as to be beyond the power of natural repair, it is possible, in fact probable, that the animal will conceive again and carry her calf normally. Evacuation of the uterus by catheter and subsequent irrigation by antiseptics, in the absence of ovarian treatment, is generally followed by a rapid re-accumulation of pus.

In an early case it may be possible to express the corpus luteum from the ovary by digital pressure, but much more often reasonable pressure fails to do so. The administration of stilbæstrol dipropionate in oil in doses of 25-40 mgm., by intramuscular injection, generally causes the onset of a profuse vulval discharge in 48 hours or so. The author's practice is to follow this, a day or so later, by pituitary extract in doses of 4-6 c.c. The discharge persists for about a week, after which the uterus undergoes involution. If frequent rectal examination is performed during this period it will be detected that the ovary which was previously large is becoming reduced in size.

Œstrus generally occurs 4-6 days after the stilbæstrol injection and is followed by regular or irregular cycles. It is customary, having provoked evacuation of the uterus, to irrigate its interior on one or more occasions with iodine solution, but the author has had cases in which pregnancy subsequently occurred without any intra-uterine medication.

(Among the cases observed by the Liverpool School, the earliest at which pregnancy has recurred in a pyometra case was 111 days after the administration of stilbæstrol.)

Salpingitis

It is orthodox to state that the anatomical arrangement of the junction of the bovine uterine cornu with the oviduct, being, as it is, funnel-shaped, favours the spread of infection from the former to the latter, and pyogenic salpingitis has long been accepted as a frequent cause of bovine sterility. In the course of the post-mortem examination of a large number of specimens of bovine genitalia visible lesions of the oviducts, with the exception of tuberculous salpingitis and strangulation of the oviducts associated with ovaro-bursal adhesions, have been few. Moreover, in a series of pyometra cases, histological examination of the tubes has more often shown them to be normal than diseased. As a high proportion of pyometra cases conceive again if treatment is forthcoming early, as also do cases of puerperal metritis, it is thought unlikely that the tendency to tubular infection is as high as has been supposed.

of a similar period and one may not be disposed to make a certain diagnosis at this time, particularly in a cow difficult of examination. Needless to say, neither foetus nor membranes will be palpated, but one of the ovaries will be of a size sufficient to contain one or more corpora lutea. In pyometra the distension is generally more tense than in pregnancy.

The greater the period elapsing between service and examination, the



FIG. 240—PYOMETRA—COW.

Width of neck of uterus 7 cm. Left ovary 4.5 cm.

Right ovary 5.5 cm. Both ovaries contain corpora lutea.
Cotyledonary areas destroyed.

easier certain diagnosis becomes. From 120 days onwards, the absence of a palpable foetus and cotyledons and the presence of a tense uterus carried high is significant evidence.

In a trichomonas infected herd, the recognition of the parasite in the vaginal mucus in conjunction with the previous findings is diagnostic.

Treatment. Treatment should aim primarily at overcoming the ovarian dysfunction, for if regression of the corpus luteum can be pro-

diameter. There is an abundant muco-purulent discharge which tends to mat the vulval tuft and tail.

The condition is most painful. The animal swishes its tail; urination may be associated with marked straining. There may be some fever, reduction in appetite and milk yield, although systemic symptoms are not severe and there is seldom much loss of flesh.

Prognosis is good. The infection does not prevent conception, nor is the development of the foetus adversely affected. Recovery occurs in the course of 2-3 weeks and is generally complete. In very severe cases, however, stricture of the vulva and posterior vagina may result from the deposition of scar tissue.

Treatment. Spread should be controlled by sexual and general isolation. On no account should affected animals be bred until they have completely recovered. The communal bull is the chief cause of spread. Artificial insemination of unaffected animals should be considered.

Daily irrigation of the affected parts using some mild, non-irritating antiseptic, taking care to sterilise all apparatus immediately after use, is generally recommended. 1/2000 acriflavine or chinisol. 1/250 zinc sulphate. Some speak highly of slightly hypertonic saline while Nielsen recommends 1 per cent. formalin twice or thrice weekly (probably a little severe). Similar treatment of the bull should be applied. All bedding should be burnt and adequate disinfection of byres and attendants' hands ensured.

Nodular or Granular Vaginitis. There is conflict of opinion as to the nature and significance of the condition so described. Many regard it to be a serious source of infertility, while others deny that it is a diseased condition at all. It is characterized by the presence on the vulval and vaginal mucosa of small nodular or granular elevations, 1-2 mm. in diameter, surrounded by a congested base and generally having a linear arrangement. The elevations comprise accumulations of lymphoid cells. It is considered by some that the condition is transmitted by coitus, and that the bull may suffer from a similar nodular balanoposthitis. The ubiquitous streptococcus has been incriminated as the cause, but the finding of streptococci of the viridans group is by no means conclusive evidence that they are pathogenic.

Of recent years the condition has been ascribed to *T. fetus* infection, but here again the evidence is quite inconclusive, and attempts to transmit it experimentally have not thrown any light on the subject. Nevertheless, many clinicians have reported a peculiar "rasp-like" feeling of the vaginal mucosa in infected animals.

Cervicitis

Cervicitis also has long been regarded as an important factor in infertility (Williams, 1919; Kingman, 1931; and Schlotthauer, 1939, in America; Webster, 1932, in New Zealand), and in this connection too, the author's views are unorthodox. He believes that what, in the past, has been regarded as an inflammation of the cervix, was in the majority of cases a physiological hypertrophy; a condition which is usual in multiparous cows. On post-mortem examination of such cases, there is no evidence of active congestion, ulceration or proliferation of the hypertrophied folds, and if a visual examination of the external protrusion of the cervix (which incidentally is the only part of the organ which lends itself readily to examination) using an illuminated speculum during life, the condition is frequently seen in pregnant animals. A point to be noted during such examinations is that pressure on the mucosæ of the vagina and cervix cause them to become deeply congested.

Hancock (1948) believes that hypertrophy of the cervical mucosa may act as a mechanical barrier to the passage of spermatozoa and quotes in support of this belief cases of hypertrophy of the cervix which were frequently returning to the bull, in which intra-uterine insemination was followed by a normal conception ratio. He also cites animals showing a purulent vaginal discharge from which *C. pyogenes* could be isolated in which the most prominent focus of infection was the cervix and in which that organ manifested unmistakable inflammatory changes.

Tuberculosis of the cervix, while it occurs, is rare.

Vaginitis

Contagious Vesicular Vaginitis. Vesicular exanthema. Bull Burn.

A specific inflammation of the vulvo-vaginal mucous membrane of cattle and the glans penis and prepuce of the bull (ballano-posthitis), of a highly contagious nature which is ordinarily transmitted by coitus, but possibly spread also by contact with soiled bedding, by attendants' hands, etc. The condition is confined to bovines and its exact cause is unknown; a streptococcus has been incriminated, but the evidence is inconclusive.

Its onset is sudden and acute; 24-48 hours after mating. Heifers are often more severely affected than cows. The vulval labiæ become swollen and tender and the mucous membrane deeply congested. This is quickly followed by the development of numerous small red vesicles on the mucosa. These may rupture early or they may develop to pustules before doing so, leaving a small, hæmorrhagic erosion, $\frac{1}{8}$ inch or so in

The forceps are taken in the right hand and passed along the left arm and hand into the vagina. Its jaws are then opened and by manipulation with the left hand, one jaw is directed into the external os and the other against the fornix on the left side. The forceps are then closed and secured by the ratchet. By gentle traction on the forceps the cervix is drawn back until it lies some 3-4 inches in front of the vulva. This provokes a degree of inversion of the anterior vagina and it is now possible to grip the cervix and hold it with the left hand. The forceps are allowed to hang from the vulva. The catheter is then directed into the vagina and, with a finger of the left hand, its tip is introduced into the os. It is pressed gently forwards. Generally an obstruction is encountered early—the first annular fold of the cervix. Withdraw the catheter slightly and rotate it; then press forwards again. In this way the lumen is detected. Continue gentle forward pressure gradually rotating the catheter as you proceed, and in this way the spiral canal is traversed. The average length of the cervix is 3 inches and it may be found helpful to have a small rubber "stop" fitted on the catheter about $3\frac{1}{2}$ inches from its tip. By this means the distance to which the catheter has penetrated the canal will be recognized. As a matter of fact it is quite obvious to the operator once the tip has passed through the cervix. The uterine body being a negligible structure in the bovine, the tip of the catheter will be directed into one or other of the cornua, depending on the direction of the curved end. If, after the injection of that cornu the catheter is slightly withdrawn and then rotated through an arc of 180° , slight advancement will direct it into the other cornu.

The catheter having been passed into the uterus, the enema syringe or gravity apparatus is attached and the solution injected. 3-6 oz. are introduced into each cornu. No danger attends the pumping method provided gentle pressure only is employed. Moreover, there is no danger of injuring the uterine wall with the catheter *provided gentleness is employed throughout*.

Occasionally it is found impossible to pass the catheter through the cervix. A second attempt should be made when the cow is in œstrus.

The question might well be asked—what does the injection do? Does it destroy the bacteria which have invaded the endometrium without causing serious harm to the epithelium itself? There is no doubt that this was the original object of the treatment. The hypothesis advanced today is that by its irritant action the injection stimulates the natural

There is no doubt that a condition indistinguishable from the one described is frequently found in animals whose breeding histories are normal. Moreover, there is no satisfactory evidence that lymphoid elevations on the glans penis of the bull are the outcome of infection either by protozoa, bacteria or viruses.

Numerous forms of treatment have been recommended: irrigation with such agents as zinc sulphate, 1-200; iodine, 1-1000; acriflavine, 1-1000 and others of the acridine dyes; the insertion of bougies containing protargol or argyrol.

INTRA-UTERINE IRRIGATION

Aqueous solutions of iodine are most frequently employed and the popular concentration is 0.1 per cent., although Kerr recommends a concentration of 1-400 in the treatment of trichomoniasis. Hindmarsh in Australia favours a 1 per cent. solution of iodine in liquid paraffin. In America suspensions of iodoform, either alone or combined with bismuth subnitrate, in liquid paraffin are popular. Common salt has its supporters in concentrations of 1-5 per cent. On the Continent the acridine dyes are used—acriflavine and Entozon.

Technique

Preparation of a 0.1 per cent. Solution of Iodine. Take Liquor Iodi Aquosus B.P.C. (a 5 per cent. solution of iodine with potassium iodide in water; known also as Lugol's solution). Add 120 minims of the solution to 12 ounces of boiled, cooled water (7 c.c. in 350 c.c.). Boil the water in a 500 c.c. flask and when cooled to blood heat, add the Lugol's solution. Plug with cotton wool.

Instruments. Nielsen's vulsellum forceps; Nielsen's 4 mm. single-flow catheter, and a Higginson's enema syringe or a Norden "simplex" gravity tube. All apparatus should be sterilized by boiling before use. (A fish-kettle sterilizer is suitable, for the instruments can be taken to the cowshed in it.)

Technique. The animal is restrained with a man at the nose and another pressing its hip against a partition. The vulval labiæ and the adjacent parts are cleansed with soap and water as also are the operator's hands and arms. It is an advantage to leave soap and water on the hand and arm to facilitate passage into the vagina. The left hand is passed through the vulva into the vagina and the cervix detected. This is comparatively easy in the multigravid cow, but is difficult in first calvers. It is generally impossible to pass the hand through the vulva in heifers.

CHAPTER 38

INFERTILITY IN THE MARE

INFERTILITY in the mare is not as common as it is in the dairy cow, and the chief causes of the condition are temporary in character. The subject has been one of considerable study in this country of recent years and in it the name of F. T. Day has been prominent.

Under different systems of management the percentage fertility of the various types of horse in this country differs considerably (Day, 1939).

Heavy horses: 59 per cent. In the majority of cases in this group the travelling stallion is called to the mare when she is observed to be in heat, and it is probable that one mating only occurs during the period.

Hunters and light horses (using premium stallions): 52 per cent. In this group also single matings during the heat period are the general rule.

Thoroughbred mares at stud: 68 per cent. With these mares several matings during the heat period are generally allowed.

Ponies running wild: 95 per cent. In these multiple matings are the rule.

Inappropriate Mating Time

It has already been noted that while there may be a wide variation in the duration of heat in the mare, the average period when regular cycles have become established by April or May, is 6 days, and that ovulation generally occurs on the day before the end of the acceptance period. As spermatozoa do not retain their fertilizing power in the genital tract indefinitely, it is necessary that mating shall occur at a time closely related to ovulation. Hammond (1938) found that the highest percentage fertility (67 per cent.) occurred from matings on the second day before the end of oestrus and that it became gradually lower as mating was made earlier in the period or on the last day. Kedrov (1938) found that mares inseminated 15-25 hours before ovulation showed 66 per cent. fertility, 2-8 hours before ovulation—68 per cent., while two inseminations during this period gave 71 per cent.

Hancock (1948) has recorded observations on ovulation time in 26 heat phases in which the periods were regular. In 62 per cent. it occurred within 48 hours of the end of the acceptance period; in 19 per cent.

luteinization of the follicle wall occurs, a condition frequently seen in the cow.

Day (1939) has described the condition of *cystic ovaries* and classifies it according to the nature of the œstrous cycles into two groups:

(a) Animals which do not show œstrus.

(b) Those which have continuous, or long, irregular periods.

The former usually have one or two large cysts and the latter, multiple small ones. He points out that cysts cannot be distinguished from follicles by rectal palpation unless the exact time in the œstrous cycle at which examination is made is known. The condition is diagnosed on the persistence of the cysts during the diœstrous period.

The chief shortcoming of our knowledge in regard to abnormal function of the ovaries in the mare is the dearth of ovarian material from mares of known history studied outside the animal's body and that most statements are based on an assessment of ovarian structure as detected by palpation of the organs *per rectum*. While such conclusions may be accurate in regard to the presence of structures such as large follicles or large persistent cysts, and also sudden changes in the size of an ovary such as occur with ovulation, the density of the organ is such that it is generally impossible to state positively what it contains by way of corpora lutea or small and medium-sized follicles even when handling the organ outside the body, and thus opinions expressed must be tempered by caution. (The reader is referred to the illustrations of the ovaries of the mare on pp. 6 and 7.)

Treatment. Numerous workers have reported on the use of gonadotrophic and œstrogenic hormones in the treatment of reproductive disorders in the mare. Day (1940) found that pregnant mares' serum in doses of 500–1000 mouse units injected subcutaneously on 3 or 4 successive days usually induced heat on the last day of injection or within an interval of 3 days after the last injection, but when injections were commenced on the 10th–13th day of diœstrus the onset of heat was not hastened. In most instances the heat induced was of normal duration and ovulation occurred. Such treatment had no effect during the period of winter anœstrus.

The same worker also found that pregnancy urine extract (luteinizing hormone) given in doses of 1000–2000 mouse or rat units by intravenous injection during œstrus induced ovulation in from 20 to 40 hours in most mares.

Burkhardt (1947) has reported on the use of stilbœstrol in oil for the provocation of heat in cases of shallow anœstrus (subœstrus) in the mare.

between 48 and 72 hours before the end; and in 19 per cent. on the 1st or 2nd day after the cessation of heat.

Nevertheless, Day (1942) using artificial insemination noted that fertility rates were good when it was performed within 4 days of ovulation and that in one case insemination was successful 6 days before ovulation. Pregnancy did not result from insemination after ovulation. It would thus appear that equine spermatozoa have considerable longevity in the genital tract of the mare, but in regard to natural service Day noted that while the uterine cervix was flaccid and dilated during the period 3 days before to 1 day after ovulation, it tended to be constricted before that time. He comments that it is unlikely that sperm would be ejaculated into the uterus when the cervix is tightly constricted.

Thus, in view of the variations in the duration of the acceptance period and in the time during or subsequent to that period at which ovulation may occur, and also to the fact that the uterine cervix does not fully relax until the later stages of heat, it is necessary in order to obtain maximum fertility that in-heat mares should be introduced to the stallion and allowed to mate on the 2nd, 4th, 6th or even 8th day until they refuse, so that a mating appropriate to all these factors will be ensured. After an interval of 14 days they should be retried on three or four occasions with 48 hours between each.

Hormonal Dysfunction

There is little doubt that in the mare also hormonal dysfunction is one of the most important causes of infertility.

A troublesome group of mares is that in which the ovarian cycle is normal but in which the general indications of heat are most difficult to detect even when she is tried with a stallion. Day (1939) comments that often the only way to catch these mares is to observe that they "show" to other mares in the paddock or by the fact that they relax and are quiet when handled "behind."

Not infrequently, foaling mares which have not been served or have failed to conceive to service at the foaling heat pass into a state of suppressed oestrus. Such mares should be frequently examined for the presence of the typical changes which occur in the vagina and cervix during heat, and if a follicle of 3 cm. or larger can be detected in the ovaries, they should be put to the stallion.

But in addition, absence of heat may be a feature of imperfect ovarian function—anovulatory cycles. It is possible that in many of these cases

Leucorrhœa. The word signifies a whitish, mucoid, non-purulent vulval discharge. The condition is generally associated with ovarian dysfunction—ovaries in which there is continuous follicle activity, but with failure to ovulate. The condition is probably associated with increased activity of the uterine glands, and tends to clear up naturally when normal œstrous cycles recur.

Endometritis. This is not a common cause of infertility in the mare. The commonest cause of the condition is delay in involution of the uterus after parturition which may occur following a normal foaling but is more commonly associated with protracted labour, retention of the foetal membranes or abortion.

The condition is diagnosed by a muco-purulent vulval discharge, the detection of inflammatory changes in the mucosa of the anterior vagina and cervix and the palpation *per rectum* of a thickened and enlarged uterus. In the majority of cases natural resolution occurs in a period of a few months if the animal is well cared for.

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In 11 out of 18 mares a dose of 5-15 mgm. by subcutaneous injection caused the onset of visible heat in a period of 2-5 days. Nine of these mares conceived to service at the induced heat. In some ovulation was spontaneous, while in others, in which ovulation was delayed, it was stimulated by the use of pregnancy urine extract—1500 units by intravenous injection.

Both Day and Burkhardt stress that hormone treatment is only likely to be successful if there is follicle activity in the ovaries and that rectal examination is necessary to ascertain that a follicle of 3 cm. or larger is present before treatment is attempted. Hormone treatment is unsuccessful during the period of winter anæstrus.

Burkhardt states that doses of stilbæstrol higher than those recommended may depress the pituitary and cause follicular atresia or even inhibit follicular growth and depress those already present.

Abnormalities of the Uterus and Vagina

Pneumo-vagina. This condition results from deformity of the vulva the result either of injury at a previous parturition or abnormal conformation of the vulva in relation to the floor of the pelvis.

Caslick (1937), in America, was the first to draw attention to the condition as a cause of sterility, generally permanent, in the mare. Certain types of vulvæ appear to predispose to a mare becoming a "windsucker"; the two most common being the perpendicular and the partial horizontal. The perpendicular type is found almost exclusively in the maiden mare while the horizontal is seen in aged mares with a sunken perineum. Overstretching and injury of the vulva at parturition are also predisposing causes as also may be too frequent and too long examinations with a large speculum.

The frequent drawing-in of air into the vagina causes chronic ballooning of that structure and in some cases of the uterus also, setting up a chronic vaginitis, cervicitis and metritis.

Caslick's Operation. The operation is generally performed with the mare in the standing position under local infiltration anæsthesia and suitable restraint. The mucous membrane of the upper half of the vulva is dissected from the skin margins and forwards for about $\frac{3}{4}$ inch and removed. The raw surfaces are drawn together with a series of Halstead sutures. Healing is rapid and uncomplicated. If catgut suture material is used there is no bother about removal. Results are excellent. In many cases the aspiration of air ceases, the inflammation of the vagina resolves and the mare breeds again.

The possibility of its existence must always be borne in mind when a bitch, particularly an aged one, is presented suffering from an obscure illness.

While it more frequently occurs in animals past middle life, it may be encountered in quite young adults. Records appear to indicate that it is more common in the maiden than in the bred bitch, but this is probably relative only for the majority are kept as pets rather than for breeding. The condition certainly occurs in animals which have bred young.

Etiology. It has long been recognized that the onset of the disease invariably occurs during the pseudo-pregnancy phase following a heat period and it was commonly accepted that the micro-organisms found in the exudate entered the uterus through the relaxed cervix at the time of heat.

A study of the endometrium of affected cases, however, has led to this view being discarded. The endometrium is found to be greatly thickened and studded with large numbers of cysts varying in size up to that of a pea. There is also erosion of the epithelium and hæmorrhage. DeVita (1939) studying the histology of the condition records an extremely complex glandular hyperplasia associated with hyperæmia and œdema followed by retrogression with necrosis, cyst and abscess formation and fibrosis.

Much of the fluid found in the uterus is the secretion of the glands, in fact occasional cases are met in which the accumulated fluid is sterile. In the majority, however, invasion by bacteria occurs and the chief clinical feature of the condition is acute toxæmia. *Bact. coli* is the organism most frequently found, but occasionally hæmolytic streptococci or staphylococci may be present. (Hughes, 1939.)

The author has examined the ovaries of many pyometra cases. In the great majority, the organs have been removed during the period which normally would have been the pseudo-pregnancy phase. These have all contained multiple corpora lutea varying in diameter from 6 to 9 mm., but there were no visible follicles. In cases which have passed beyond the pseudo-pregnancy period, both corpora lutea and large (12 mm.) hæmorrhagic follicles have been noted. DeVita has also recorded a long-standing case in which the ovaries contained corpora lutea and cysts.

It is now generally accepted that hormone dysfunction associated with the ovaries is the primary cause of the condition resulting in gross glandular hyperplasia, and that bacterial invasion is secondary. As to

CHAPTER 39

INFERTILITY IN THE BITCH

OF the forms encountered the following are the most important:

- (a) Absence of heat in mature animals.
- (b) Uterine hyperplasia with pyometra.
- (c) Fœtal mummification.
- (d) Death of newly born puppies.

Absence of Heat

This is the commonest form of infertility regarding which advice is sought. The usual history is that the bitch has attained the age of 1½–2 years and has not had a heat phase but otherwise is completely healthy and normal. On post-mortem examination of such cases the ovaries are found to be of the *immature* type; small, oval and regular in shape with no visible follicles or remnants of corpora lutea on section—hypoplastic juvenile ovaries (Benesch and Koster, 1935). In others, the history is that the animal, now 3 or 4 years old, has not shown heat signs for a year or more.

Attention is only directed to bitches of the definite breeds and as a rule only to those under middle age. As to the breed incidence, Scorgie (1939) reporting on 18 cases, quotes 8 greyhounds, 6 cocker spaniels, 2 Bedlington terriers and 1 of each Sealyham and fox terrier.

Scorgie has recorded the use of gonadotrophic hormones in the treatment of the condition. Irrespective of breed or size he administered simultaneously follicle stimulating and luteinizing hormones by subcutaneous injection ("Antostab" Boots, 187 mu., and "Physostab"—Boots, 50 mu.). Of 18 anæstrous bitches so treated, 14 came on heat in from 2 to 6 days, while in 2 others the onset of heat was delayed 17 and 19 days respectively. In 2 the treatment failed to induce heat. Thirteen of the animals were mated at the induced heat and 9 of these conceived and carried their puppies to term.

Anæstrus is common in aged fat bitches—genital adipose dystrophy.

Uterine Hyperplasia with Pyometra

The incidence of pyometra in the bitch is high, in fact the disease is recognized as one of the most common causes of death in this subject.

accelerated, but it may be impossible to distinguish the acceleration of toxæmia from that of nervousness at being handled.

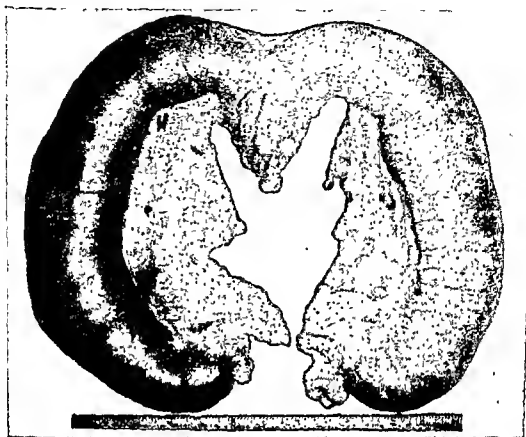


FIG. 241.—PYOMETRA IN THE BITCH SHOWING THE GROSS UTERINE DISTENSION OF A CLOSED CASE.

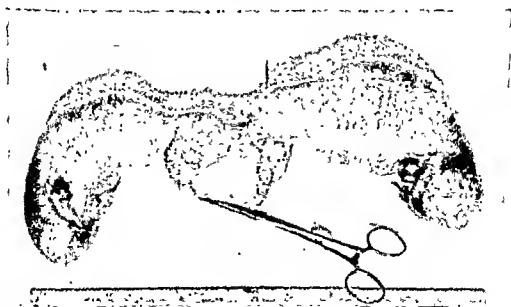


FIG. 242.—PYOMETRA IN THE CAT.

the source of the bacteria, it would seem likely that they attain the endometrium *via* the blood or lymph streams and find the abnormal mucous membrane a favourable environment in which to multiply.

A similar condition occurs in the cat, but is less common.

Symptoms and Course. When a complete and reliable history is available it is found that the animal was in heat a few weeks previous to the onset of ill-health. Quite often in those cases in which there is vulval discharge the owner regards it as a continuation of heat.

If the case is presented early, the general history is that for the past 3-4 days the animal has been dull, its appetite reduced or completely lost. Thirst is an invariable symptom and there may or may not have been vomiting.

In another group, the history is that the bitch showed symptoms such as have been outlined, some 10-14 days previously, but since that time there has been a vulval discharge. In these cases the cervix has, to a degree, relaxed and much of the pus has escaped. This escape has been accompanied by improvement in general health.

In another series the animal has been ill for a longer period than that described in the first group but there has been no discharge. It is noticed that the abdomen is becoming distended and pregnancy may be considered. The bitch, however, is severely ill. These cases generally end fatally in a period of from 14 to 21 days from the onset of symptoms, the cervix remaining closed throughout. Death may be due to toxæmia alone or it may be associated with peritonitis due to perforation of some part of a cornu. In some cases of this group, the cervix relaxes and there is a flooding of pus just before death.

In a fourth type there may be a succession of openings and closures of the cervix, with discharge and relative good health in the former and accumulation and malaise in the latter. Such cases generally succumb from toxæmia in the course of a month or two.

Some open cases may go on for years with a more or less continuous vulval discharge.

In several closed cases the author has seen a profuse discharge of blood from the vagina, in fact the owner has sought advice primarily because of this.

Body temperature shows considerable variation. In open cases it may be normal or there may be a rise of $t-2^{\circ}$, seldom more. In closed cases a rise in temperature is general, particularly in the early stages— $103-105^{\circ}$, but it is by no means invariable. In acutely toxæmic cases temperature is often subnormal. Pulse rate is not a useful guide. It is generally

colon by the distended uterus using barium sulphate emulsion to outline the former organ. (A gum-elastic catheter is introduced into the empty colon some 8-10 inches and barium sulphate is injected as the catheter is gradually withdrawn. In this way the colon becomes evenly filled by the contrast substance.) Displacement of the colon to the mid-line or to the right of it is good supporting evidence that the uterus is distended.

Treatment. As a rule the veterinarian is concerned essentially with saving the animal's life and the question of restoration of fertility seldom arises. Hysterectomy has long been the standard treatment for the condition, and in a series of over 200 cases, some of which were closed, others open, and showing varying degrees of toxæmia, the author has had a 70 per cent. recovery rate. An advantage of hysterectomy over simpler forms of treatment is that recovery when it occurs is complete and it is probable that the bitch will live a normal life for many more years.

Stilbæstrol. Brancker (1943) has recorded the use of stilbæstrol. Of 16 cases treated, 8 made complete recoveries. In the majority normal œstrus recurred with no return of pyometra. Of the remaining 8, 2 again developed the condition at the succeeding heat, and 4 recurred at varying short intervals of 2-6 weeks. One of the first group and 2 of the second recovered after a repetition of treatment. Her procedure is to give 1-3 mg. stilbæstrol by intramuscular injection and a course of a sulphonamide drug by the mouth. If there is no sign of heat after 48 hours a second injection of stilbæstrol is given. If œstrus is present an injection of posterior pituitary extract is given and repeated as required. Heat usually persists for a week and stilbæstrol is given every 5 days to ensure a continuous flow from the uterus. Pituitary extract is given at intervals of 24-48 hours to increase the rate of discharge. This treatment is continued until the fluids from the uterus appear to be normal and then a final injection of stilbæstrol is given to reduce the risk of infection remaining.

This is an advance and there seems little doubt that stilbæstrol should be the first line of treatment and surgery reserved for those cases which do not respond to treatment or those in which the condition recurs after a subsequent heat. Nevertheless, care must be taken and in those cases in which the action of the drug is delayed or inadequate and it is evident that severe toxæmia is developing, hysterectomy should be performed at once.

It is probable that stilbæstrol acts primarily by causing functional regression of the corpora lutea and it is of interest to note in this

The character of the vulval discharge varies. Most often it is of thin consistency, light chocolate-brown in colour and having an indescribable but characteristic odour. In others it is yellow in colour, often blood-tinged and varying from a watery to a creamy consistency. The vulva itself is generally hypertrophied. The hair beneath the vulva and at the back of the thighs and hocks is frequently wet or matted.

Abdominal Palpation. Before commencing the animal should be given the opportunity to empty its urinary bladder and the colon if full should be emptied by an injection of soapy water or glycerine. In open cases of pyometra the cornua can generally be detected as thickened, often irregular, more or less turgid tubes, from $\frac{1}{2}$ to 1 inch in diameter. Their position in the abdomen will not be greatly altered. In exceptional cases some parts of the cornua are turgid and solid to the touch while others which are distended by pus offer very little detectable to the fingers. In large, fat or "awkward" subjects it may be impossible to carry out satisfactory abdominal palpation without previous narcotization. Care must be taken not to confuse the colon occupied by faeces with a thickened cornu. In open cases the presence of a vulval discharge is, in itself, very strong evidence of the disease.

In a closed case the degree of uterine distension at the time the animal is presented for examination is generally similar to that which normally exists at the 7th or 8th week of gestation (Fig. 241). Quite often there is visible abdominal enlargement. Generally the degree of resistance offered by the distended cornua is insufficient to make their detection by palpation certain, although the complete abdominal relaxation obtained by nembutal anaesthesia is a great aid.

Rectal Examination. With the index finger inserted as far as possible into the rectum and with the animal's foreparts raised, it is generally possible to detect the distended uterus in front of the pelvis. Backward pressure on the abdominal wall will facilitate this. It is very seldom that distension of intestine by gas occurs to a degree whereby it can be detected by rectal examination, while distension of the urinary bladder is obvious on abdominal manipulation. By way of differentiation also, it is generally possible to palpate the normal uterine body forwards as far as the bifurcation by digital examination per rectum and if the uterine body is normal to the touch it is highly probable that the cornua are also.

Radiography. Radiography has been exploited as an aid to diagnosis in closed cases of pyometra (Wright, 1933). In some cases, especially in small bitches, it is possible to recognize the shadows of the distended cornua. Attempts have been made to demonstrate displacement of the

colon by the distended uterus using barium sulphate emulsion to outline the former organ. (A gum-elastic catheter is introduced into the empty colon some 8-10 inches and barium sulphate is injected as the catheter is gradually withdrawn. In this way the colon becomes evenly filled by the contrast substance.) Displacement of the colon to the mid-line or to the right of it is good supporting evidence that the uterus is distended.

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It is probable that stilbæstrol acts primarily by causing functional regression of the corpora lutea and it is of interest to note in this

connection that Lesbouyries and Berthelon (1936) reported that recovery may follow ovariectomy. But it must be pointed out that in the majority of clinical cases it is impossible to locate the ovaries without severe manipulation of the uterus and having regard to this and to the fact that the uterus is the essential focus of disease, it is best, if extensive intra-abdominal interference is to be performed, to remove that organ also.

Marsupialization. Williams (1947) has drawn attention to marsupialization in the treatment of acute closed cases. The operation is performed under general anaesthesia or narcosis with local infiltration anaesthesia. He describes it as follows:

The animal is fixed in the lateral position. The distended uterine horn is made to bulge subcutaneously by placing a small sandbag or similar object under the opposite flank thus forcing the abdominal contents upwards. The skin incision is made vertically, about 2 inches long, over the most prominent part. When the peritoneum is penetrated, the uterine horn generally presents firmly in the incision sealing it off effectively against the escape of other viscera. The exposed ellipse of uterine wall is now secured to the margins of the outer muscle incision by five or six interrupted sutures. An eyeless, full-curved intestinal needle carrying No. 0, 10-day chromicized gut is essential for good results. Each suture is laid by passing the needle down through the muscle layer into the uterine lumen, taking a firm bite of about $\frac{1}{4}$ inch of the uterine wall parallel to the edge of the muscle, returning up through the muscle layer to be tied on the surface. When the uterus has thus been firmly anchored to the abdominal muscles, a central puncture is made preferably with a thermo cautery. The uterine contents may gush out, but occasionally very little escapes. The surrounding tissues should be thoroughly packed off for protection. A rubber drain comprising a 6-inch length of $\frac{1}{4}$ -inch tubing is inserted and fixed in position by a single suture through the uterine wall. The entire area is sprinkled with sterile sulphanilamide powder and covered by a thick gauze pad to absorb the drainings. Subsequent treatment consists of changing the dressing twice daily. The entire uterine contents drain away in 3-4 days. The skin is not sutured and the muscle incision is usually obliterated by the time the drain is removed. The skin fistula heals slowly in about 21 days.

Having regard to the tendency to recurrence, Williams recommends the subsequent removal of the uterus about 3 months later. In his cases the uterus was always normal in appearance when removed. He points out that some difficulty may be experienced in dealing with the adhesion

of the uterus to the abdominal wall but overcomes this by making a slightly longer incision in the abdominal wall than usual, thus giving better access to the abdomen.

He claims that the results attending this form of surgery are considerably better than primary hysterectomy in such cases.

Hysterectomy. It is generally the intention to remove the ovaries in addition to the uterus, but in this connection the operator will be guided by the facility or otherwise with which ligatures can be placed

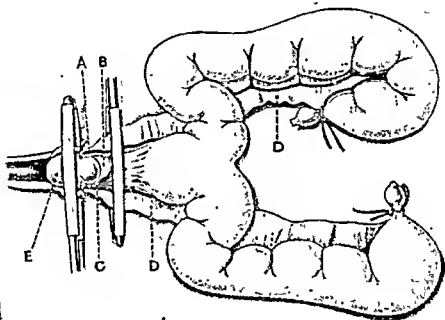


FIG. 243.—HYSTERECTOMY FOR PYOMETRA IN THE BITCH. UTERUS DRAWN OUT OF THE ABDOMINAL CAVITY AND REFLECTED BACKWARDS.

A, uterine vessels. B, cervix. C, line of section. D, broad ligament. E, anterior vagina.
(*Veterinary Record.*)

beneath them. If, particularly in fat bitches, traction on the ovarian ligaments is likely to cause uncontrolled tearing and possibly severe hæmorrhage, one or both should be left. No serious harm will result therefrom although there is a possibility that the bitch will develop abnormally long heat periods in the future.

Intravenous nembutal is the best anæsthetic. Care must be taken that injection is made very slowly from the outset and careful watch kept for

the onset of anæsthesia, for the toxæmia of pyometra greatly increases the animal's susceptibility to the anæsthetic.

The technique of operation up to the point at which section is made through the posterior part of the uterus is the same as that already described for cesarian hysterectomy (p. 353).

Posterior section is made through the uterine cervix or the anterior vagina immediately behind it. Bowel forceps are applied in the usual way and the uterine arteries are ligated immediately in front of the

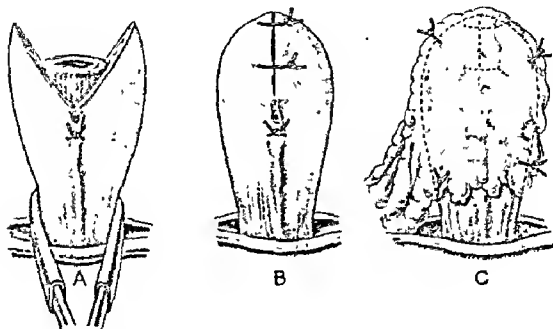


FIG. 244.—METHOD OF CLOSURE OF STUMP.

A, flap incisions of anterior vagina immediately behind cervix. B, suture of the flaps, avoiding the mucosa. C, omentum is applied to the stump.

(*Veterinary Record*.)

posterior pair (Fig. 243). The anterior pair of forceps are applied tightly to prevent any possible escape of pus when section is made, while the posterior pair are applied lightly in order not to crush the vagina severely. Section is made by dorsal and ventral flaps. If it is found that the mucosa tends to protrude, a little of it should be snipped away. Other than wiping with gauze, no treatment is applied to the stump. The stump is closed by three or four sutures taking in the serous and muscular coats only (Fig. 244). Before allowing the stump to return to the abdomen, care should be taken that hæmostasis is complete. It should be held with spring forceps and the bowel forceps removed. A

the puppies derived the infection from adult carriers, but later (Stafseth, 1940) failed to reproduce any of the syndromes described by injecting dogs with streptococci in pure or mixed cultures and suggested that viruses or other pathogenic factors might be the provocative or pre-disposing causes.

Hare and Fry (1938) recording an extensive study of the presence of *beta* hæmolytic streptococci in the tissues of dogs, associated the organisms with a variety of clinical syndromes, including sterility, adenitis, septicæmia and infection of suckling puppies. In the last condition they isolated streptococci from the pharynx and the vagina of bitches in kennels in which the disease was occurring. From the puppies they isolated streptococci sometimes mixed with *Bact. coli* and staphylococci. Of 29 strains of *beta* hæmolytic streptococci isolated by them, 28 belonged to Lancefield's group G, and the remaining one to group A.

Stableforth (1938) also reported that the majority of the organisms he had recovered from dogs were of group G, but that others had fallen into group C, and one had belonged to group B. He commented that it was obvious that streptococci were associated with many conditions causing serious losses amongst dogs, but we had yet to learn their exact importance in all these conditions.

Minett and Ellis (1940) considering the specificity of the streptococci that can be isolated from these genital infections of the bitch, stated that while from general considerations they saw little room for doubt that the organisms were responsible, they considered it necessary to examine swabs from a number of normal breeding animals. From a number of such "normal" bitches (in that they had reared litters) hæmolytic streptococci were isolated, but Minett and Ellis questioned their normality because some of them had showed delayed œstrus. (The author would question the assumption that delay in the onset of œstrus was sufficient abnormality in itself to indicate bacterial infection.) Nevertheless, from other bitches in which they considered the history to indicate normality, no hæmolytic streptococci could be isolated. These workers also found that the treatment of bitches carrying the organisms in their genital passages with full doses of sulphanilamide and M. & B. 693 was unsuccessful.

The role played by *beta* hæmolytic streptococci (B.H.S.) in the causation of this and other clinical syndromes in the dog is by no means proven. Even Hare (1946), who has been the chief promoter of the belief held by many in this country that these organisms cause widespread disease among dogs, acknowledges that "his work on the B.H.S. infection

would remain provisional and incomplete until it had been reproduced experimentally."

Vaccines have been widely used in the treatment of the condition. Clinical reports as to their value have been variable. Of recent years penicillin has been administered to newly born puppies in kennels in which the disease is prevalent, but as yet no critical reports are to hand. Stewart (1928) in Australia has reported good results following the injection subcutaneously to the puppies immediately after birth of 3-4 c.c. of citrated maternal blood.

Having regard to the uncertainty of the significance of the streptococci found in these cases, other possible factors in the causation of the disease should be sought. Particularly should attention be directed to the diet of the bitch during her gestation. The author has noticed in many of the kennels in which the disease is prevalent that feeding mainly comprises foodstuffs which have been sterilized—proprietary biscuits and feeding meals and dried milk. Care should be taken that adequate provision is made for vitamins and minerals.

The author is not aware of any other form of widespread infertility in the bitch which can be ascribed to bacterial infection.

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